# The Foundry Trade Journal

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## Forthcoming Event.

AUGUST 8, 9, & 10.
*British Foundrymen's Association.*—Annual Convention at Glasgow.

## NOTES AND COMMENTS.

### The Education and Training of an Engineer.

The Civil Engineers' Conference on this subject, which we report on another page, again brings before the public eye a problem of more than ordinary importance. It would hardly be an exaggeration to say that the high standing of practically every branch of our industries is greatly dependent on the training and education of our engineers; and if any evidence of the effect of a sound educational system is required, one needs but to turn to Germany and observe the rise of her industrial life since the Bismarckian policy of severe organisation in all things affecting national education was instituted. The last decade has witnessed considerable growth in the movement for industrial and technical education in all directions, but in this country the lack of organisation amongst the numerous secondary schools, colleges and universities, and the lack of co-operation between these bodies and engineering employers, is a severe drawback to the efficient operation of our educational schemes. It may here be stated, however, that Scotland must be omitted from this indictment, for in that country the educational system follows closely on the lines of the German plan. The relationship between the secondary schools and the colleges and universities is extremely close, and there is not the difficulty of the private (and too often inefficient) school or college which enters into the scheme in the South country. In fact, the deficiency pointed out by Mr. J. W. Horne may almost be said to be a failing peculiar to London and district; in no other centre do the same conditions obtain. As regards the lines along which progress might reasonably be developed, we cannot do better than refer to the important suggestions put forward by Mr. Horne. That these suggestions are the result of sound practical experience and extended acquaintance with technical education and the training of engineers, will be appreciated by those who know their author. When those suggestions were put forward at the Conference, however, Mr. Alexander Siemens advanced the opinion that it was absolutely impracticable to arrange to take young men from the schools into the workshops in the way that had been suggested. There might, he admitted, be businesses here and there where such a practice could be carried out, but in the vast majority of instances it was not possible. When students came into the shops they would be required to do their regular work, and if they were allowed to go away on one afternoon each week they might as well stay away altogether as far as regular work in the shops was concerned. Mr. Siemens, apparently, had quite misinterpreted the idea in the paper. It was not suggested that firms should bind themselves to take any students that were put forward from schools, but that they should receive the best of the college-trained students. At the same time, we are convinced that there is even greater scope for the taking of boys who have passed their matriculation in the secondary schools, and training them in the shops preparatory to the colleges or university course. In fact, during the last three years at least

two firms in the South of England, Messrs. Vickers, Ltd., Erith, and Messrs. Fraser & Chalmers, Ltd., Erith, have given 12 to 18 engineering pupils and trade apprentices the privilege of attending afternoon technical classes on two afternoons each week, thus assisting them to attain a college education eventually, and we believe the system has so far worked with considerable success.

**Training the Apprentice.**

During the discussion, Professor Kapp said that the course proposed by Mr. Horne was precisely that being carried out in Birmingham for clever boys coming from the secondary schools. But the former apparently confused the concluding paragraph of the Paper with Mr. Horne's earlier suggestions. That concluding paragraph, relating to the higher education of apprentices, we regard as the most important of the whole Paper. The idea is to help trade apprentices to the universities, and not university students to works practice. Bristol University, we believe, is working on similar lines to those suggested by Mr. Horne, and arranges to take trade apprentices with maintenance allowance who have proved themselves capable of duly profiting by a University course. A philanthropic disposition on the part of the employer is not necessary for the success of the scheme; a clever boy from the secondary school, if started on practical training in an engineering works, and encouraged to qualify for a university course, becomes a very useful unit in the works, by reason of the intelligence he applies to his work, and the employer is not at a loss on his behalf. On the other hand, to take indiscriminately as pupils in the factory students from the university, may quite easily prove an expensive procedure. This has been somewhat exemplified in the case of Germany, as outlined by Mr. Franz zur Nedden. In that country the whole subject was considered by joint committees of all the leading engineering institutions, and the practical results arrived at in 1899 were that, first, a resolution was passed by all the technical universities that no young man should be allowed to enter as a student qualified to pass the final examinations and to graduate as a diploma-engineer, who had not passed 12 months in the workshops of an industrial works or repairing shop; further, there was drawn up a code of rules as to the conduct of the training by those responsible for the management of those works; and, also, an official list of 500 works was compiled, the managers of which had by signing the code of rules declared themselves willing to receive a limited number of engineering students in their shops and to conduct their training according to those rules. Unfortunately, however, the hopes which were set upon the active support of the system by the great industrial works have not been fulfilled, largely on account of financial considerations. But we might here remark that one important failing of the German system is that the individuality of the boy is not considered. The scheme outlined by Mr. Horne for the assistance of suitable boys from the secondary school through the works to the college or university, however, certainly does consider the question of individuality; the first few months at practical work is usually sufficient to show the capabilities of the boy for engineering work, particularly after the selective process of the secondary school examinations.

**From College to Works.**

A point put forward by several speakers who favoured the completion of the student's practical training before attempting the college course was that after the latter the student would have attained an age that would prevent him successfully entering with the youths and mechanics in the works to learn practical matters. This argument we would at once discount; for at the age of say from 18 to 22 years no young man who is fit for an engineer should be unable to enter the lower ranks to learn. If at that age he cannot bring himself to take on the shop routine of early hours and hard work, in the interest of his own education; if he cannot rub shoulders with the grime of the foundry and the grease of the fitting shop in order to get into touch with the information which can only be so acquired, he is not of the stuff to make a successful engineer, and is better out of the profession. Badly though we need competent engineers for foundry managers, we require them to have had a proper acquaintance with works practice. Just one more point on the same line; engineering students are often liable to overlook the fact that a few years' college and university training does not necessarily qualify them as wage-earning units in a works. Too often we find the acquirement of a certain amount of technical and scientific knowledge accompanied by an attitude of undue superiority to master and fellow workers alike, the assumption on the part of the student in question being, apparently, that he is already a valuable asset to the works. We have, in such cases, sometimes heard the young man designated a decided nuisance. This trouble, however, is not likely to occur with students whose merit and endeavours alone have sent them to the front ranks, and it is this class that will prove to be the backbone of the profession.

## Early Bronze Founding.

Despite the high-class brass and bronze castings that are now being turned out, one cannot always suppress a sense of admiration for the work of the old masters of the craft. In almost every quarter of the globe are to be found examples of very early bronze founding, and especially in certain countries the art appears to have developed to an eminent degree. But those who have cast admiring glances on, say, some of the examples of Japanese work recently exhibited in London, will perhaps be surprised to learn of the artifices employed to patch up castings which a Western shop would discard on sight. According to the article on Japanese bronze castings, which we publish on another page, the success of their methods appears to be dependent on a plentiful supply of very cheap labour—a requisite which is not associated with our metallurgical industries. Nor would their products, apparently, pass the eye of a modern foundry inspector. But, nevertheless, the East has produced some really admirable specimens of the foundry art; specimens which have stood the test of centuries, and are still in good condition. As testimony to the fact that the ancient craftsmen were no haphazard workers may be quoted the following interesting note on bronze casting in Siam, which appears in the Journal of the Royal Society of Arts:—

According to old records, the art of bronze casting was introduced into Siam by the Chinese in the eleventh century. Bronze, however, has been known throughout Indo-China since the earliest times, as shown by the discoveries of bronze hatchets and arrow-heads in limestone caves and other places of deposit of pre-historic remains. Ancient bronze figures of Indian divinities and of the Buddha testify to the early employment of the bronze founders in these cults in Siam. Figures of the Buddha are found in the north of Siam in great numbers on the site of ancient temples which have been crumbling

for centuries, leaving the majestic bronze figures standing enclosed by great forest trees. The interesting point about these figures is the perfect condition of the bronze after centuries of exposure to a tropical sun and rains. This bronze is called by the natives "samrit"—the perfect or auspicious alloy—and its composition for a long time remained a secret, until, according to the American Consul at Bangkok, a few years ago the formula was discovered in an old Siamese manuscript belonging to the late King of Siam, of which the following is a translation:—"Take twelve ticals (one tical less is equal to one half-ounce avoirdupois) weight of pure tin, melt it at a slow fire, avoiding bringing it to red heat. Pour two ticals weight of quicksilver, stir until the latter has become thoroughly absorbed and amalgamated, then cast the mixture in a mould, forming it into a bar. Take one catty in weight (eight ticals) of refined copper and melt it. Then gradually incorporate with it the amalgam, keeping in the meantime the fused mass well stirred. When this has been done, throw into the crucible a sufficient quantity of ashes obtained from the stems of the 'bua-bok' (lotus) creeper, so as to cover the molten metal. Remove the dross with an iron ladle; the metal remaining is samrit bronze." According to this recipe, the proportion of the ingredients employed in the manufacture of the alloy in question thus proves to be 85.11 copper, 12.76 tin, and 2.13 quicksilver. One of the best known statues of the Buddha cast of samrit bronze may be seen in the city of Pitsanuloke, Siam. This figure dates from the beginning of the eleventh century, and ranks among the most beautiful objects of art that the Siamese have ever produced. Samrit bronze was also much used in old days for casting vessels and implements for sacred uses, and was supposed to be endowed with mystic qualities. The art of casting bronze Buddhas still forms quite a home industry. The method followed is to mould a figure in clay and coat it with wax, and then apply a coating of clay; the wax is melted by the application of heat and the molten metal poured in. When cold, the mould is broken, and the figure cleaned and polished. In the temples of Bangkok may be seen many fine specimens of modern statues of the Buddha, which compare favourably with those of other countries.

## British Foundrymen's Association.

### The Coming Convention at Glasgow.

For the Eighth Annual Convention of the British Foundrymen's Association, which will be held at Glasgow on August 8, 9, and 10, an exceptionally important and interesting programme has been arranged. The visitors from a distance will assemble at the headquarters of the Convention on August 7 (Bank Holiday). The business will commence at half-past nine on Tuesday morning, with the Annual Meeting of the Association for the election of officers, and presentation of the Report of the Council. At a meeting of the Council recently held in Birmingham, it was decided to nominate Mr. Percy Longmuir, B.Met., Carnegie Medallist, for election for a second year to the Presidency. Mr. C. Jones (of Cardiff) will be nominated as Senior Vice-President and Mr. S. A. Gimson (of the Engine Works, Leicester) as his colleague. The Honorary Treasurer, Mr. F. W. Finch (Gloucester) and the Secretary, Mr. J. E. H. Allbut, will be nominated for re-election. For the nine seats on the Council which will have to be filled there are 14 nominations. The Balance Sheet to be presented this year is a very favourable one, and is considered by the Council a demonstration of the wisdom of the recent alteration in the Rules. For the first time in its history, the British Foundrymen's Association has beaten its American prototype in the matter of membership. At Christmas, the number of members of all classes aggregated 718, and a great number of elections have since taken place.

The civic welcome to the Association will, this year, take the form of an evening reception, which will be given by the Lord Provost and magistrates of the City of Glasgow in the Municipal Chamber on the Wednesday evening. Very great interest has been taken by the Glasgow Branch and other local friends in the preparations for the visit of the Association. A strong committee was formed some time ago with ex-Bailie King of Glasgow (President of the Glasgow Branch) as its chairman. The meetings will be held in the West of Scotland Technical Institute (Andersonian Buildings). It will be remembered that when in 1905 the Second Annual Convention of the Association was held in Glasgow, the meetings took place in the same buildings, the conference being the first to be held after the opening of the building, the foundation stone of which had been laid a year or two before by the late King Edward VII. For the afternoon of Tuesday a visit to the works of Messrs G. & J. Weir (Cathcart) has been arranged, and for the Wednesday afternoon one to the works of the North British Locomotive Company (Hyde Park, Springburn). As usual, the Thursday will be occupied by a pleasure excursion which will take the form of a sail on the Firth of Clyde to the Kyles of Bute and round the Isle of Arran.

The members of the Convention have also been invited to visit the Exhibition now being held in Glasgow.

The following is the list of Papers to be read:—

Tuesday, August 8: "Cast-iron for Foundry Purposes," by H. Pilkington, M.I.C.E., (Past-President); "Steel Castings," by Prof. Campion, F.I.C., F.C.S.; "Warping in Castings," by R. R. McGowan (Glasgow).

Wednesday, August 9: "Carbon Control in Cast-iron," by R. Buchanan, F.S.A. (Past-President); "The Crystallisation of Cast Metals," by C. H. Desch, D.Sc., Ph.D.; "Metallography as an Aid to the Ironfounder," by J. S. G. Primrose, A.G.T.C., A.I.M.M.; "Art Expressed in Castings," by W. F. Bagnall (Sheffield).

## The "B.F.A." and Educational Matters.

Since the British Foundrymen's Association is an educational body whose officers have from time to time been engaged in various educational movements, it is not surprising to find a member of that Association taking a prominent part in the discussion on the training and education of engineers before the Conference of the Institution of Civil Engineers. It will be seen on reference to the report of that Conference which we publish on page 464, that the contribution by Mr. J. W. Horne, Vice-President of the London Branch of the British Foundrymen's Association, contained some of the most important suggestions submitted—suggestions which should appeal strongly to all who are interested in technical education and training.

Mr. Horne, who holds the degree of Bachelor of Science (Edinburgh University), was for several years

head of the Science Department in Glasgow Academy —one of the largest secondary boys' schools in the West of Scotland, accommodating 400 boys. He studied chemical technology and did research work in organic chemistry under Professors Lunge and Bamberger at Zürich Polytechnic, and later occupied the position of metallurgist with Messrs. Wm. Baird & Company, Limited, Gartsherrie and Eglinton, where he gained considerable experience in the manufacture of Scotch iron and Scotch hematite iron, and also in coke-oven practice, etc. Mr. Horne has also done a considerable amount of prospecting work in Spain, Portugal, and Algeria. He now occupies the position of metallurgist with Messrs. Fraser & Chalmers, Erith, where he controls and superintends the education of the pupils and apprentices, while he is also a governor of the County School and Technical Institute, Erith. Mr. Horne is, further, an

Mr. J. W. Horne, B.Sc., Assoc. Inst. C.E.

Associate of the Institute of Civil Engineers, and a member of the Iron and Steel Institute. It will be seen from the foregoing that he is in a position to speak with some authority on technical training and education.

The movement for the deeper consideration of technical educational matters has now been on foot for several years, and each year sees some additional advance made. It may fairly be expected, therefore, that before long the British Foundrymen's Association will be involved officially in the movement to place our English systems of technical education on a satisfactory basis. It is an important question alike for the foundryman and the mechanical engineer, for each in future will, of necessity, require a higher technical training than in the past. We may therefore regard it as encouraging to find amongst the officers of the British Foundrymen's Association a number of men who have this question at heart, for their endeavours will not by any means be wasted in that field; in fact, there is probably no other branch of engineering where so much raw ground has yet to be broken, and in which the services of earnest workers are more to be appreciated.

## Non-Ferrous Vanadium Alloys.

In the course of a Paper on "Vanadium Alloys," presented recently before the Mining and Metallurgical Section of the Franklin Institute, Mr. G. L. Norris dealt briefly with the non-ferrous vanadium alloys. Extracts of the Paper are as follows:—

Cupro-vanadium usually contains about 3 per cent. of vanadium. The eutectic alloy contains about 7 per cent. vanadium. Mixtures containing a high percentage are not desirable, on account of the very high melting point and consequent difficulty in getting it into the alloys.

Vanadium has as yet hardly entered the field of non-ferrous alloys, although probably in the near future it will be found occupying almost as prominent a place in these alloys as it does at present in steel. The principal reason for the apparent lack of progress has been the difficulty of producing cupro-vanadium free from undesirable metals, notably iron and aluminium.

Vanadium has a very high electrical resistance, and the addition of only a few hundredths of a per cent. reduces the conductivity of copper in a very marked degree. A few hundredths of a per cent. will increase the elastic limit, tensile strength, and ductility of copper from 10 per cent. to 20 per cent.

About the first reference to the use of vanadium in non-ferrous alloys is by Helouis. He produced some experimental bronzes, notably an aluminium-bronze, 94.5 per cent. copper and 5.5 per cent. aluminium, with 0.5 per cent. vanadium, which gave a tensile strength of 97,336 lbs., as against 49,770 lbs. per square inch for the same alloy without vanadium.

Vanadium has a very similar effect on the copper alloys to that it has on steel. It increases both the elastic limit and tensile strength very materially and does not impair the ductility. Usually the ductility is increased. A recent test of vanadium in a common brass or Muntz metal, 60 per cent. copper, 40 per cent. zinc, gave the following results:—

| | Without Vanadium. | With Vanadium (Trace only). |
|---|---|---|
| Ultimate strength ... ... | 38,000 lbs. | 49,000 lbs. |
| Elongation in 2 in. ... | 28 per cent. | 45 per cent. |
| Reduction of area ... | 30 per cent. | 42 per cent. |

The increase in resiliency by tests on notched bars was a little over 80 per cent.

Tests of vanadium in manganese bronze gave the following results:—

*Tests.*

| | Manganese Bronze. | Manganese-Vanadium Bronze. |
|---|---|---|
| Elastic limit ... ... | 30,560 lbs. | 50,560 lbs. |
| Ultimate strength ... | 54,160 lbs. | 81,440 lbs. |
| Elongation in 2 in. ... | 22 per cent. | 12 per cent. |
| Reduction of area ... | 18 per cent. | 14 per cent. |

*Composition.*

| | Manganese Bronze. | Manganese-Vanadium Bronze. |
|---|---|---|
| Copper ... ... ... | 58.81 per cent. | 58.56 per cent. |
| Zinc ... ... ... | 38.08 ,, | 38.54 ,, |
| Aluminium ... ... | 1.22 ,, | 1.48 ,, |
| Manganese ... ... | 0.60 ,, | 0.48 ,, |
| Iron... ... ... | 0.84 ,, | 1.00 ,, |
| Vanadium ... ... | — | 0.03 ,, |

A very considerable amount of vanadium-bronze is being made of a composition similar to manganese-bronze, but without manganese. The alloy is very strong, forges readily, and resists corrosion to a very high degree. It is being used extensively for marine work, especially in torpedo and submarine boats. Torpedo tubes are now made entirely of this metal, and parts such as exhaust headers, valves, and air cylinders to withstand heavy pressures.

# Die-Casting Machines.*

By E. F. Lake.

The process of making castings in metal moulds and having them within 0.0005 in. of the correct size, and with a surface as smooth as if machined, has been kept a secret for many years. Essentially it consists of injecting molten metal with considerable pressure into a steel die, opening the die, ejecting the casting, closing the die, and injecting more metal. The idea was probably suggested by the line of type that was automatically cast by the type-setting machines, or by the lead bullets that used to be cast in iron hand-moulds. The process has developed steadily from the bullet moulds, and each individual that has been brought in contact with it has added improvements of one kind or another, with the result that better castings are now being made than was possible in the early stages of the industry. Sufficient pressure is applied to the metal to make it fill the steel mould completely and prevent shrinkage after it solidifies. In this way a surface as smooth as though finished with machine tools is obtained, and castings several inches in size will not vary more than 0.001 in. from the required dimensions.

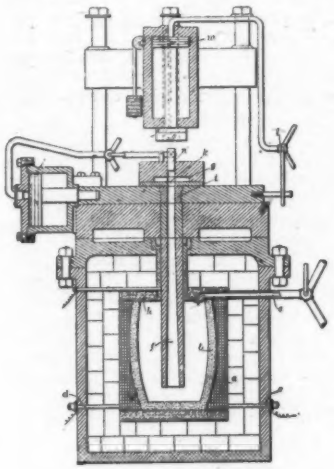

FIG. 1.—A MODERN PNEUMATIC DIE-CASTING MACHINE IN WHICH THE METAL IS KEPT MOLTEN BY ELECTRICITY.

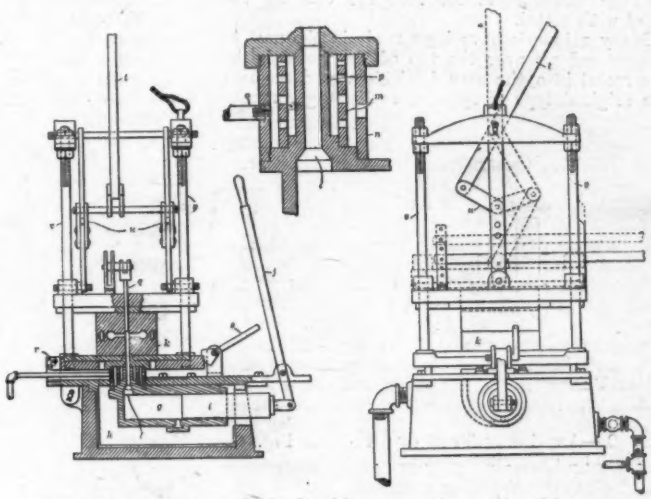

FIG. 3.—AN UPRIGHT, HAND-OPERATED PLUNGER MACHINE.

## Casting Metals.

Up to the present time castings have been made only from metals that form a white alloy, but the writer has the necessary data to build machines that will cast some types of brasses and bronzes, and possibly other metals that are even stronger. The white-metal alloy that is now cast is quite brittle, and not as strong as yellow or red brass. It must melt at a temperature low enough not to destroy the steel mould, which means that most die-moulded castings are made from alloys that melt at temperatures between 500 deg. and 800 deg. Fah.

Zinc, tin, copper, lead, aluminium, antimony and bismuth have been used in various combinations to make an alloy that could be cast without blemishes and have the necessary strength, lead, tin, zinc, and antimony being most commonly employed. Fahrig metal, composed of 91 per cent. tin and 9 per cent. copper, Parsons white bronze, containing 65 per cent. tin, 29 per cent. zinc, and 4½ per cent. copper, and pure Banca tin have also been cast successfully in the die-casting machines. The more reliable die-casting firms are now sending out castings where the metal is solid all the way through and possess considerable strength. The metal, however, has not yet been made as strong as ordinary brass.

There are several conditions that must be right before castings that are sound and strong can be cast exactly to size in steel moulds. First, the machine that contains the melting pot and injects the molten metal into the mould must be correct in design and easily operated; second, the metal alloy that is to be cast must be of the right composition; third, the temperature of the casting metal and the die-mould must be at the proper degree; fourth, the die-mould must be smooth on the inside, true to size, and parted and vented properly; fifth, the shrinkage must be controlled or allowed for, or both; and sixth, the time allowed for making each casting and removing it from the mould must be correct. The third and sixth conditions are controlled by the operator of the machine; the metallurgist should decide the second entirely and the fifth partially, while the tool or die maker should meet the fourth condition and aid the metallurgist in solving the fifth. This leaves only the first condition. As the whole process is based on this, the machine is therefore the most important factor.

B

* From "The Iron Age."

### A Modern Machine.

One of the latest machines designed for rapidly casting the white-metal alloys in steel moulds is shown in Fig. 1. In this type a resistance coil *a* surrounds the crucible *b*, in which the metal is melted. The electric current enters and leaves the coil at *c* and *d*. Compressed air is injected into the melting chamber at *e*, which is made tight by the slab *h*, and forces the molten metal up through the tube *f* into the steel die-mould *g*. When the mould is filled with molten metal the slide valve *i* is pushed over by the air piston *j* until it closes the hole *k* in the mould. The compressed air is then turned on at the valve *l*, and the piston *m* forces the plunger *n* down in the mould until the metal completely fills the mould and becomes solid.

The operation of the pistons and the other moving parts can be controlled automatically, which leaves very little hand work for the operator. The opening of the mould, ejecting the casting, and closing the mould to receive the next casting can also be done automatically, so that all the operator would have to do then would be to see that the crucible was kept filled with metal.

Many attempts have been made in the past to force compressed air over the top of the metal bath to get the metal into the mould. This was done because in the original type of cylinder and plunger machine the plunger would stick owing to a thin film of casting metal getting around the bearing surface of the plunger and freezing, with the result that the plungers had frequently to be removed for cleaning and often had to be replaced with new ones. As the plunger was located in the melting-pot, which was placed inside the furnace chamber with the die-mould over it, the machine practically had to be taken apart to remove and to replace the plunger. Even though compressed air for forcing the metal into the mould has been tried by many different firms, it has in time always been abandoned. This was due to the fact that the percentage of poor castings was too great to allow the air-pressure machine to become a commercial success.

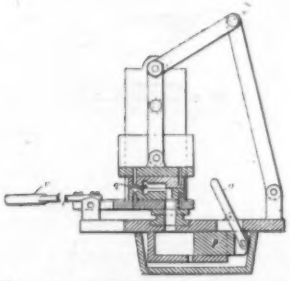

FIG. 2.—AN EARLY TYPE OF DIE-MOULDED CASTING MACHINE.

One of the earliest types of die-moulded casting machines is shown in Fig. 2. When the lever *o* was pushed backward it moved the plunger *p*, and this forced the metal under pressure into the mould *q*. The lever *r* was then pulled over to cut off the metal so the casting would have no gate, or show imperfections where it had been located. The casting was then removed from the mould, and the machine made ready for the next casting.

### Quick-Acting Upright Machines.

In Fig. 3 is shown one of the later types of upright hand-operated plunger die-casting machines. It was designed specially for speed in opening and closing the mould. As in the simpler machine illustrated in Fig 2, the metal is kept molten in the cylinder *g* by gas flames which surround it in the chamber *h*. The plunger *i* is forced in by the lever *j* to squeeze the molten metal into the mould *k* through the nozzle *l*. Around the discharge passage *l* is located a heating chamber, an enlarged sectional view of which is shown in the upper part of the drawing between the two main views of the machine. This chamber is formed by two rings *m* and *n*. Gases are sent through the pipe *o*, and are burned in the spaces between the discharge nozzle lining *p* and the rings *m* and *n*.

This chamber was designed to obviate one of the greatest troubles with die-moulded casting machines. The passage between the mass of molten metal and the die-mould must of necessity be so small that the metal is apt to stay there long enough to become solid and clog up the passage. If the metal did not remain there long enough to freeze, small portions would be left after each casting was made, and these would accumulate until the passage was filled. This would cause the machine to be stopped and kept idle long enough to clean out the passage. Hence something had to be devised to prevent the clogging, and the above mechanism is one of the designs that have proved successful. When the mould has been squeezed full of molten metal the rod *q* is forced down by a lever. It traps the metal in the mould until it solidifies, and cuts off the balance of the molten metal so it will drop back into the cylinder *g*. This has been designated a sprue cutter, and where there is a hole in the centre of the casting this is without doubt the best form of sprue cutter. The rod can be made to the exact size and shape of the hole desired, and the casting will mould to the rod. Where the casting has no centre hole the sprue cutter has to be placed in other parts of the mould, in other positions, or take an entirely different form.

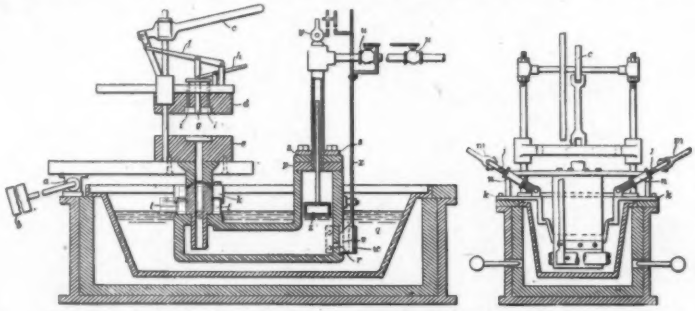

FIG. 4.—A MACHINE OPERATED BY AIR PRESSURE WITH A TILTING TABLE FOR THE MOULDS.

To set the die-mould in the correct position for moulding, the upper part of the machine is tipped back on the hinge *r*. When set, it is again placed in the upright position and locked by the eccentric that is moved by the lever *s*. To remove the casting, the lever *t* is swung to the upright position. This operates the toggle joints *u* that raise the upper half of the mould on its guide rods *v*, of which there are four. The position taken by the lever and the toggle joints when the mould is opened is shown by the dotted lines in the right-hand view of Fig. 3.

Fastening one half of the die-mould on a plate and moving this plate up and down on rods by toggle joints is a means that has been employed to a large extent on die-casting machines. As the metal is forced into the mould under considerable pressure, the two halves of the mould are likely to be forced apart and open at the joint unless they are securely held. A toggle joint of this design is simple, and when well fitted will hold the two halves of the mould together

against much more pressure than is met with in present methods of die-casting. It is well adapted to hand-operated machines, but other devices are probably better when the casting machines are made more automatic.

### An Air-Pressure Machine.

Fig. 4 illustrates a machine that has a pressure chamber submerged in a melting pot. The view at the right is a section through one end of the machine, with the air line and the valve bridge broken away to show the arrangement of the gate, and the die-mould also removed. The metal enters the pressure chamber through a port near its bottom, and thus keeps on a level with the molten metal in the melting pot. From here it is forced by air pressure up into the mould.

The moulds are located on a table that is hinged at *a* and counterbalanced by the weights *b* so it can easily be tilted. The lever *c* is used to raise and lower the upper half of the mould *d e*, and thus open and close the mould. The lever *f* operates the sprue cutter *g*, and the lever *h* operates the rods *i i*, which are used to push the castings out of the mould. Tie rods *j j*, hinged to lugs on the bracket *k*, swing into slots cut in the plate *l*, and by turning down the levers *m m* the eccentrics on their ends clamp the mould halves and their entire mechanism to the chamber containing the molten metal, and from which it is forced up into the mould. The turn-buckles *n n* are used to adjust the eccentrics to the proper length for clamping tightly.

In the mechanism that holds and operates the mould this machine is very similar to other die-casting machines. The principles adopted here have become almost the universal and standard practice. On some machines the apparatus looks very crude, and in some instances better mechanical principles could doubtless be applied. The pressure pot and its pressure and intake mechanism are very different from those of other machines. The main body of the pot is a casting, with the discharge nozzles *o* screwed into it and the cover *p* bolted on. The pot is located beneath the surface of the molten metal in the melting pot *q*, except at the round end where the air is injected and at the extreme end of the nozzle. It is held in position by the cross-bars *s* and the lugs *t*.

The molten metal flows from the melting pot through the port *r* and into the pressure chamber. Air is then injected into the pressure chamber through the valves *u u* to force the metal up through the nozzle *o* into the mould *e* when it is closed. Two valves are used as a check on one another in case one should leak. Air leaking into the pressure chamber would cause the molten metal to flow out through the nozzle *o* when the mould was opened to take the casting out, and thus cause trouble. For an additional safeguard the levers of the valves *u u* could be connected with the upper mould plate in such a manner as to turn off the air before the mould was opened.

To take metal into the pressure pot through the port *r* it is quite essential that there be no air pressure in this pot, as that would cause the metal to flow out of instead of into the pressure pot. The slide *v* covers the port *r*, and is held in place by the plate *w*. To this slide is attached the rod *x*, and this in turn is attached to the lever of the pet cock *y*. Thus when the slide *v* uncovers the port *r*, the pet cock *y* is opened to let out any air pressure that might be in the pressure chamber. This method of opening and closing the intake port is the only practical and successful one that can be used when it is to operate underneath the surface of molten metal. An ordinary valve and valve seat soon accumulate oxide and dross, and these lodging on the seat make the valve fit poorly and cause a leakage of air. This leakage reduces the air pressure in the pressure chamber, and hence the metal will not enter the mould with force enough to completely fill all parts. To prevent the air from striking the surface of the metal forcefully, a float is located at *z*. A rod is fastened to the upper side of the float, and moves up and down in a tube to hold the float in position and prevent it from wedging or jamming and thus becoming fastened to the walls of the pressure chamber. If the air were allowed to strike the molten metal with its full force it would

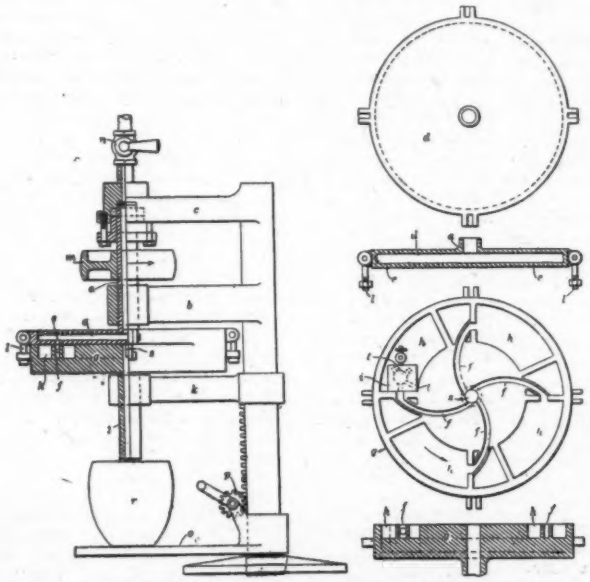

FIG. 5.—A NEW MACHINE, UTILISING THE PRINCIPLES OF VACUUM AND CENTRIFUGAL FORCE.

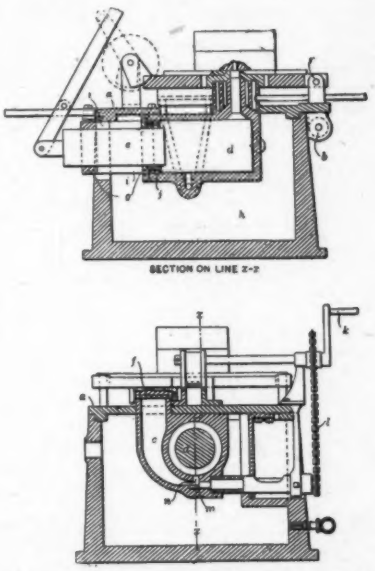


FIG. 7.—RECENT IMPROVEMENTS MADE IN THE PLUNGER TYPE OF MACHINE.

cause the latter to splash, and the flying particles would lodge on the air inlet and freeze, and eventually close the opening.

In this machine the designer has reduced the troubles inherent in the air-pressure machine to a minimum. These troubles, however, have not been entirely removed, nor can they be when air presses directly against the surface of the metal, since, if the air pressure on the surface of the molten metal is sufficient to force the metal into all parts of the mould, some of the air is bound to be absorbed by the metal and thus form oxides and dross, resulting in porous and spongy castings. This tendency has been reduced to a minimum by extending the discharge nozzle to the bottom of the pressure pot so it will only take in the cleanest and densest metal, by placing the inlet port *r* near the bottom of the pressure pot for the same reason and so it will not take in any of the dross that gathers, and by confining the air pressure to a small space in a compartment of its own that is removed a considerable distance from the discharge nozzle.

### Vacuum and Centrifugal Force.

The machine shown in Fig. 5 is radically different from the others described, and is based on a principle that should make it work successfully. Experimental castings have been successfully made in it, and it will soon be given commercial work to do. The shaft *a*, running in bearings on the arms *b* and *c*, is hollow, and terminates in a vacuum chamber *d*, with openings at *e*. These openings are located directly over the curved ports *f* in the mould carrier *g*. The ports open into the chambers *h* in which the moulds are located

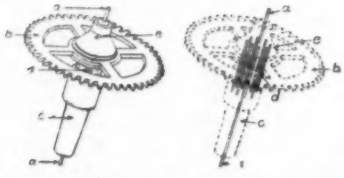

FIG. 6.—ONE OF THE BEST EXAMPLES OF WORK DONE WITH DIE-CASTING MACHINES.

with their in-gates directly opposite the port openings, as shown at *i*. A second hollow shaft *j* is attached to the bottom of the mould carrier, and runs in a bearing on the arm *k*. Lugs on mould carrier enable a vacuum chamber *d* to be bolted to it with pivotal bolts *l*.

To operate the machine, the vacuum chamber and the mould carrier are revolved by a belt running on the pulley *m* in the direction shown by the arrow. The valve *n* is then opened, and an air pump sucks the air out of the shaft *a*, the vacuum chamber *d*, the curved ports *f*, and the moulds *i*. The table *o* is next raised by the pinion and the rack *p* until the hollow shaft *j* is near the bottom of the crucible *r* The partial vacuum in the upper part of the machine causes the metal to rise out of the crucible through the opening *s*, and the centrifugal force of the mould carrier, aided by the vacuum, causes the metal to flow through the ports *f* into the moulds *i*, the vents *t* helping the metal to fill all the corners of the mould. When the castings are completed the bolts *l* are unhooked, and the mould carrier *g* is swung on the arm *k* out from under the vacuum chamber *d*, so that the castings may be removed. Four pockets for moulds are provided in this carrier, but this number may be made more or less according to the size of castings made.

With this type of machine the plunger is done away with, and hence all the troubles connected with it. The melting pot with a submerged pressure chamber is also eliminated. There it is very difficult to keep the metal hot enough in the pressure chamber without making it too hot in the melting pot. While air is used in this machine, it is drawn away from the metal to create a vacuum, and not compressed and forced down upon its surface. Thus air is used in the proper way, and no injurious effects should be seen in the metal.

If the vacuum and the centrifugal force can be controlled so as to fill the moulds completely before the metal chills, and not clog up the machine, this should be one of the best methods established for making die-moulded castings. With it an ordinary oil- or gas-heated melting furnace or a crucible may be used to melt the metal, and the machine attached in a manner to draw the metal out.

The above machines illustrate the fundamental principles that have made the casting of low-fusion alloys a commercial success. The making of castings to accurate measurements from metals or alloys of a much higher melting temperature is the next step in the evolution of the industry, and is bound to revolutionise some parts of the foundry business.

Casting machines are in use that are belt driven and automatic and semi-automatic. One machine is entirely automatic, and is working daily in a Western American clock factory. It makes the wheel, the pinion, the staff, and the pivots in one piece, as shown in Fig. 6, by casting a white-metal alloy around them. First the wire forming the pivots *a a* and the rounds of the pinion at *d* are unwound from a reel, straightened, and pushed through accurately-fitting holes in the die-mould. These holes locate the wires absolutely in the correct position, and the staff at *c* is cast around them. After this the mould opens and a perforated zinc disc is dropped over the pinion wires to hold them in position and act as a stop to the next half of the casting. A brass wheel *b*, which has been previously formed with a hexagonal centre large enough to clear the steel pinion wires *d*, is next dropped into the mould, which is then closed. After this the part of the staff at *e* is cast, and the casting thrown out of the machine. This is all done automatically, and all the attendant has to do is to keep the machine supplied with zinc discs, brass wheels, and a reel of wire.

This method of inserting steel pieces, or those made of brass and bronze, in the moulds, and then casting metal around them, is carried on quite extensively; in fact, the reinforcement of die-moulded castings is common practice among the firms making this kind of castings, due to the inherent weakness of die-cast metals. None, however, have carried the automatic machine to the high state of perfection that this clock company has. The wire used for the trundles *d* in this lantern pinion is 0.021 in. diameter, and the holes through which it passes into the die-mould must be accurately spaced and of the correct size. If too small the wire will jam and stop the machine, and if too large the metal will squeeze out around the wire and spoil the casting. Thus the holes act as a gauge for the wire, which, being held as it is, ensures a correctness of size and shape in the piece and a uniformity between the various pieces cast that could not be obtained in any other way.

### Improvements in the Plunger Machine.

In Fig. 7 is illustrated some improvements on the former types of plunger machines. The plate that holds the lower half of the die-mould and is hinged at *r* is the same as that shown on the machine in Fig. 3, as is also the furnace *h* and the specially-heated discharge passage. Like the older machine, the plate *a* is hinged at *b*, and to its underside is

fastened the melting pot *c*, the casting cylinder *d*, and the plunger *e*. These are suspended in the furnace chamber *h*, and surrounded by gas flames. A charging spout leads up through the plate *a* from the melting pot *c*. The cover to this spout is shown at *f*, and it is only necessary to remove this when new metal is added. The metal is usually melted in auxiliary furnaces, and poured into the casting machines.

This machine differs from that illustrated in Fig. 3 in the diameter of the cylinder and plunger, and the method of getting the molten metal into the cylinder. The plunger *e* is made considerably smaller in diameter than the cylinder *d*, and slides in a sleeve composed of the two collars *g*, held together by eight ribs like the two shown at *i i*. This is made of nickel steel, and is machined outside and inside. To prevent the cylinder from leaking around the plunger, an asbestos washer *j* is placed next to the collar *y* on the inside of the cylinder *d*. As the plunger is so much smaller in diameter than the cylinder they do not touch at any point, and there is no danger of the two brazing or soldering together. In the ordinary designs of plunger and cylinder, as shown in Figs. 2 and 3, the molten metal would squeeze in between them, harden, and thus stick them together. Dross would also gather around the plunger, and make it work hard. This was another source of trouble in the die-casting process, and often meant that the machine had to be taken apart, the metal taken out, the plunger removed, the plunger and cylinder cleaned of the casting metal, and the whole reassembled. Many different ways have been tried to overcome this.

While this design greatly reduces the danger of the plunger becoming stuck by the casting metal, special arrangements have to be made to get the molten metal into the cylinder. A better plan might be to draw the plunger out far enough for the inner end to rest on ribs, and thus allow the molten metal in the melting pot *c* to flow around the ribs and into the end of the cylinder *d*. When the plunger was forced in it would trap the metal that flowed into the cylinder *d*, and force it into the mould.

The eccentric that locks down the mould plate that is hinged at *r* is thrown in and out by the crank *k*. This also turns a sprocket wheel, around which runs a sprocket chain that turns another sprocket wheel at *l* at the bottom of the machine. This in turn moves the rod *m*, one-half of which is cut away at the inner end, and thus opens and closes the port *n*. Through this port the metal flows from the melting pot *c* to the cylinder *d*.

After the plunger has been pulled back, and while the mould is being opened to remove the casting and closed again, the rod *m* may be turned to the position shown in the lower portion of Fig. 7. The metal then flows into the cylinder *d* from the melting pot *c* to replace that which has been used in making the former casting. When the crank *k* is turned to clamp the mould into position for making another casting the sprocket wheels and chain turn the rod *m* and close the port *n*. After this the plunger *e* is moved forward to force the metal up into the mould for making this other casting. This form of valve could be used to keep the casting metal in the melting pot until ready for use. The temperature could also be higher than if the metal were allowed to flow into the cylinder freely, as in the ordinary casting machine. In this way metals of a higher melting temperature can be die-cast, providing the melting pot, the cylinder, the plunger and the moulds can be made of a metal that will stand the higher temperature.

The use of automatic, semi-automatic, or hand-operated machines depends largely on the number of castings that are to be made. As die-casting machines are always built by the users, they can be made in the style that is the more economical. Any number of die-moulds may be used on one machine, as these can be fitted in such a manner as to be easily and quickly interchangeable.

## A View of the Foundry at Close Range.

In the course of a Paper by B. D. Fuller, before the American Foundrymen's Convention, the author made the following comments:—

There is nothing in connection with the foundry more worthy of careful study and constant watching than the sand. Where men are working a sand which is not suitable, through being too close to stand hard ramming with a minimum use of the vent wire, coke bed, or other means of carrying away gases; or, the other extreme, a sand too sharp and lacking in bond, contributing towards loss through wash, or drop out, I will guarantee that, given the same men, sand properly mixed and tempered and of a nature to stand ramming, containing bond enough to stand up well in pockets or overhanging projections in the mould or core, and at the same time vent freely, a very marked improvement in quality will be found, as well as decrease in cost of product. Time devoted to ascertaining the correct proportion of new and old sand in facing and core mixtures, to seeing that mixing machines are properly operated, that the right proportion of binding material and no more is used, is well spent.

It may, on first sight, look like extravagance to allow rope slings to be used through a shop on core and moulding floors where chain or iron beam and sling could be used. But when we figure the gain in time, due to the speed of adjusting a rope which adapts itself to all shapes, I believe, in many cases, it is an actual economy to use them. Also we can see when a rope has outlived its usefulness, as it will give warning, where a chain will snap unexpectedly, often causing accidents.

Construct patterns for the machine direct from the drawings where at all feasible, for not only do we save the cost of original patterns, but save money on every casting. Small castings made by hand from loose patterns cannot be compared as to quality or cost with those made upon machines from proper patterns. In regard to patterns other than those for the moulding machine, second only to the machine in importance is the match plate system, *i.e.*, not simply plates with one-half pattern on each side to ram cope and drag upon the same plate, but parts on separate boards or plates; as is true of the machine, the more intricate the design, the more they are worth. In some cases as many as four separate plate patterns for a four-part mould are being used, and there are patterns up to eight feet, and even larger, from which castings are produced. Here again, the man not considered the finest mechanic will produce good work. He cannot abuse the pattern by beating it with a hammer, as he cannot reach it. The gates are formed as part of the pattern, thus doing away with a source of much loss and trouble, for many a job is spoiled in the cutting of the gate.

As a general thing these match plates can be drawn from the mould by means of the simple guide pins in the flask, leaving a perfect mould, but when the draw is too intricate for this method to be successful a simple drawing device can be applied by hand to the match plate after the mould has been rammed and rolled, which will give a perfect mechanical draw, leaving the same as fine as any machine-made mould.

# Pattern Shop Management.

By W. V. D.

In many pattern shops, with proper management and the intrdouction of a good system, a saving of 33 per cent. to 50 per cent. can be effected. It would be impossible to adopt the same system to all pattern-shops, large and small; that which would be applicable to a large one, of say 70 to 100 men, would be unsuitable to a shop of 10 or 15 men, but nevertheless, the main ideas may be modified or extended to suit any particular shop.

In nearly all general engineering shops, during a period of national good trade, there are intermittent times of boom and slackness, and by the nature of the engineering business, the pattern-shop is invariably the first to feel the effects in either case. If a boom, the first effort made to cope with the incoming work is the engaging of as many fresh hands in the pattern-shop as it will possibly hold, and often more than the room will allow for expeditious work by each man.

The writer will assume for the present purpose, that the shop under consideration is capable of benching 40 pattern-makers at a time of good trade, that the introduction of any more would cause cramping of working room, and that during slackness the number would probably be reduced to say 15, a not at all unusual example. During the period of slackness it is quite evident that whatever machinery the shop contains is only being worked at less than half its capacity. If the machinery is still worked to its full capacity with less than half the number of men, it is obvious that when the shop is filled up with men, a great deal of waiting will take place at the machines, or a great amount of the work has been hand labour instead of machine work. This has been and is still the case in many shops.

We have said that the pattern-shop having an inrush of work, the first thing is the engaging of as many men as can be benched. Let us see what this means in cost of wages to a firm whose shop is the size under consideration. Twenty new hands at £2 per week is equal to an increased weekly wage bill of £40, which for six months would mean at least £800, allowing for lost time, sickness and holidays. Supposing that 10 men are engaged instead of 20, and the difference in wages, viz. £400, is spent in machinery, and agreeing that that amount would purchase at least three machines and that each machine, if worked to its full capacity, is equal to three men (a low estimate) we arrive at this result: at the end of the six months the same amount of work has been produced and the firm is £400 worth of machinery in hand. It is easy to calculate the continued benefit to the firm financially at the end of twelve months.

How aggravating and worrying it is to a foreman to see repeatedly during the day, one, two, or sometimes more men, marking time until the band-saw or planing machine is at liberty; only those who have held the post, and whose work in the shop is on estimate, know. Again, a further saving can easily be effected in those shops already containing an adequate amount of machinery, if band-saws, planing-machines, trimmers, sanding-machines, lathes, etc., are given constant attention to keep them efficient. The difference between their highest efficiency and the loose indifferent state they are mostly in, is easily 50 per cent.

A planing and thicknessing machine, if in proper working order, carefully attended to, and worked by a man up to standard, will so finish the wood that no further planing by hand is necessary. After the wood or timber has been marked off and set out, and, say, requires sawing by the band-saw, it should leave that machine so near a finish that the sand-papering machine will do it; if it does not, then the band-saw is much below its true efficiency. The object is to get the utmost work out of these machines with the least possible cost.

Take for example, a shop containing one surfacing, and one thicknessing machine, one 36-in. band-saw and one 24-in. band-saw, one dimension saw, three wood turning lathes, one disc and one belt sand-papering machine, the usual large and small trimmers, say six. For our present purpose we need not include saw sharpeners, gouge grinders, wood driller, etc., which, it should be unnecessary to say, quickly earn their first cost. A pattern-shop containing this machinery would or should be large enough in floor space to bench 40 to 45 men and boys, together with four machine-men, who should use and keep up to their highest capability all the machines enumerated above.

One man and a boy should work the two planing machines, the boy helping the man for at least three months before he is allowed to use either machine alone. One man and one boy should run the two band-saws, and another man the dimension saw. It is astonishing what one of these latter machines will do at the hands of a competent man, but if at all neglected it is not only useless but dangerous. A man and a boy should take up all the lathe work, which leaves the sanding-machines, trimmers, etc., for use by the pattern-makers. It would be the duty of the foreman, as he found best, to apportion the upkeep of the trimmers, etc., amongst the four machine men and boys.

Each pattern-maker should be supplied with a fly-leaf book ruled and printed as shown herewith. When a pattern-maker has received a drawing and instructions from his foreman he should fill in the form or sheet for the whole of the timber he requires for the pob. The example herewith is a typical form shown filled up. This form should be passed on with templates, if any, by a boy to the foreman's office, and the foreman should then send it through first to the timber shed, where the lengths and widths would be most economically sorted. The short pieces would be taken from the "scrap" heap. The timber and form would then pass forward to planing machines, afterwards on to the places as noted on shown filled up. This form should be passed on office, and the foreman should then send it through first to the timber shed, where the lengths and widths of the wood would be sent to the bench; the pieces with them to the band-saw. The pieces for the lathe shows that the thickness of 8 inches can be built finds his stock. The sketching of a square under "ends" means the ends are to be trimmed off square to the lengths given.

The results obtained from a system on these lines are that the machines are kept up to standard, the responsibility for neglected machinery can reasonably be placed on the man in charge, and there are less repairs. The machine-man's wages are 15 per cent. to 20 per cent. less than pattern-makers, and owing to

constant employment at the machine he becomes a more skilful worker, and the work done by him costs less. No pattern-makers are kept waiting for machines, and no time is lost in going backwards and forwards from bench to machines, etc.

No columns in the forms should be left blank. If no particulars are to be shown a line should be drawn through, and no alterations of figures should be allowed. If a wrong figure or dimension has been put down, the pattern-maker should cross the figures out and put new ones in on the next line. This will place responsibility for mistakes on the man who makes

TIMBER SHEET

Name - G. Jones  No - 348

Date - June 30-1911

Rule - Iron  Contraction

Initials

Works Order No. - 4646  Time - 6½ hrs.

| No of Pieces | Length | Width | Thickness | Ends | Remarks |
|---|---|---|---|---|---|
| 2 | 5'-2" | 7" | 1¼" | □ | Bench |
| 3 | 1'-6" | 3" | 2" | – | " |
| 1 | 2'-9" | 6" | 1½" | □ | " |
| 40 | – | – | ¾" | – | Template |
| 12 | – | – | 1" | – | " |
| 1 | 3'-3" | 8" | 8" | – | Lathe |
| 2 | 24" | 5¼ | 1 3/16 | □ | Bench (Wrights) |
| | Scrap wanted at Bench | | | | |

them, and assist also in reducing those odds and ends that accumulate so rapidly in most pattern-shops. At the end of the day's work the pattern-maker should fill in his time on the form, whether any timber has been used or not, initial it, and hand it into the office as he goes out. A correct record is thus kept of the amount of material used, the workman's wage number, works order number, date, etc., for the shop clerk's purpose of entering up.

The boys assisting the machine-men should be passed on from machine to machine, say every six months, until they reach the bench. They thus grow up with the system, and by these means fall readily into the way when they themselves become bench hands.

## Cast Arbors and Dry Sand Moulds.

Writing on "The Foundry at Close Range," before the American Foundrymen's Association, Mr. B. D. Fuller says:—

When large cores are made in quantities the use of cast arbors as a means of safety and economy is generally overlooked. What though it does mean some time daily required from carpenter or pattern-maker building and fitting arbor patterns to the boxes? When once you have a stock of arbor patterns it more often means but a slight change to adapt an old pattern to a new job. Suppose it does require one or two men moulding these open sand arbors every day; the cast arbor will save days of time in cutting and shaping wrought-iron or steel rods, will give a firmer and more stable core, and enable the coremaker to use fine coke or venting material, where he otherwise could not make use of it.

The practice of drying moulds may be carried to an extent which may at first sight seem an extravagance. One can sometimes walk into a shop and see right and left the burning of charcoal in pans suspended in moulds, or charcoal in mass upon a sheet of corrugated iron covering a mould; but this may be an economy, in that men who would require years of careful training to make thorough green sand moulders, can in a comparatively short space of time be taught to do good work through dry sand methods. The mould can be rammed harder, it requires less venting, and when wet blacked and slicked, and gone over with a final plumbago wash, will give surer results, provided the facing sand is right. Where gas is obtainable this is one of the best agents available for mould drying, as burners may be formed for jobs which are in day after day, and operations such as drying drag cheek and cope of the same mould at the same time with the one burner can be carried out, thus saving time, money and space. But for irregular work of odd shape, and work in and out, there is nothing better than charcoal.

## Correspondence.

[*We accept no responsibility for the statements made, or opinions expressed, by our correspondents.*]

### New-Old Ideas.

To the Editor of the FOUNDRY TRADE JOURNAL.

Sir,—Remembering the old saw, "There is nothing new under the sun," it is, perhaps, natural that one should at times wonder if it is worth while writing on a technical subject, for fear that something has already been written about the same. This thought was very forcibly brought home to me recently, on referring to a number of technical periodicals of about seven years ago. In one of these I found an article describing a process of moulding a large spur wheel that was too large to be done on the moulding machine in the ordinary way. My attention was drawn to this because, only a few weeks previously, I had a similar wheel to make, and after spending some time in thinking the matter over, I made it in the way described, with a very slight variation. At the time I thought the method was so good, that I decided to write it up and submit it for publication, with the idea that it might help someone else; with this object I had already partly written the article.

Although I have not the slightest recollection of reading the previous article, it may be presumed that I had seen it at the time, but probably owing to it not presenting itself to my mind as likely to be useful I had not taken sufficient notice of it. However it was, the fact remains that the two jobs were very similar, and so would the articles have been had I finished mine. I can only account for the similarity by assuming that, although I took no notice of it at the time, the impression had been left unconsciously in a corner of my brain.

What I wish to emphasise is the almost unconscious benefit accruing to most, if not all, readers of technical papers. It may be that no immediate use can be made of what is read, or we may read about something that is not even interesting at the time, but the seed is, nevertheless, sown, and in all probability will bear fruit in due season. The foregoing should not discourage anyone from writing, as it may safely be left with the editors to discriminate and judge on the various articles submitted; because an article on a certain subject has already been printed, it by no means follows that the last word has been said about it, for the later writer may treat the same subject in a totally different manner.

Yours, etc.,

"W. P."

# Electric Steel Works Practice in Germany*.

After gaining satisfactory experience with a small (14-cwt.) Röchling-Rodenhauser furnace in 1907, Messrs. Le Gallais, Metz & Co., of Dommeldingen, decided to adopt the system on a larger scale; and it is now stated that they have found not the slightest reason to regret this step, the furnace producing excellent steel. The electric power is generated in two central stations, the motive power for which is supplied by blast-furnace gas. In addition to meeting its own requirements in respect of power, the plant has also to supply the town of Luxemburg with three-phase current at 5,000 volts and 50 periods. For the requirements of the electric steel plant, the original three-phase is converted into single-phase at a transformer station. Each of the transforming sets consists of a synchronous three-phase motor for intermittent work, 140 h.p., 500 volts, 50 periods, and 485 r.p.m.; a single-phase alternating generator 825 to 950 k.v.a., 3,000 to 3,500 volts, 25 periods; a synchronous three-phase motor, 715 h.p., 5,000 volts, 50 periods; and an excitation machine for 110 volts and 210 amperes. All these machines weigh in the aggregate about 50 tons.

To prevent the inconveniences arising from the earth vibrations produced by the working of the steam hammers, the transformer plant and switchboards have been housed some distance away. Current is conveyed to the furnace plant by means of lead-sheathed cables, asphalted and reinforced with iron bands. The cables are laid in a large brick conduit, along with the other conductors leading to the working machines, cranes, lamps, etc. Air shafts are provided for ventilation.

The main building consists of five bays, each 330 ft. long and 36 to 60 ft. wide, built of constructional iron-work with brick filling, the roofs being of pumice concrete. This building houses the furnaces, foundry, fettling plant, finishing shop and forge. The northern bay contains the electric furnaces and mixer, mounted on a concrete platform 10 ft. above the floor, an arrangement facilitating access to the furnaces on all sides. There is no need to describe the construction and method of working the furnaces, both being well-known, except to say that the plant consists of three single-phase-alternating furnaces and one three-phase furnace. The former are all of the one type, namely, to deal with a 3½-ton charge, and consuming 380 kw. of electric energy, at a tension of 3,500 volts and 25 periods per second. The windings are cooled by air delivered by a fan, the air having been freed from impurities by means of a filter, in order to prevent contamination of the pipes and transformers. This arrangement acts so well that in spite of the close vicinity of the bath of molten steel at a temperature of 1,600 to 1,700 C., the windings can be readily kept down within the prescribed limit of temperature. The furnaces are mounted on rollers, and are tipped electrically, being adapted to tilt forward through an angle of 45 deg. for discharging, and 17 deg. backward for drawing off the slag. These operations are controlled from an enclosed switch-room, about 3 ft. above the platform, and equipped with various necessary appliances, as well as with telephone communication to the power house and transformer plant.

The transformer for the 1½-ton three-phase furnace is designed for a maximum consumption of 280 kw. and a tension of 500 volts at 50 periods. The arrangements for cooling, tilting, etc., are similar to those already described. In order to deal suitably with the class of raw material available, the furnaces have a basic lining of dolomite and tar.

The time occupied in working a charge varies from 2 to 3 hours, according to the product desired, and the average consumption of energy for a 3½-ton charge is 350 to 390 kw. The furnaces work very uniformly and the current curve is almost a straight line, the only fluctuations being those produced designedly. The working life of the furnace lining is 90 to 125 charges, without repairs; the walls then need renewal, but the bottom and vault will last out several new walls.

The metallurgical process is as follows:—Hot metal is brought from the blast furnaces in ladles, and after being partially refined in a Wellman furnace, is finished in the electric furnaces. The Wellman furnace is basic-lined and has a capacity of about 20 tons, the hearth measuring 20 ft. by 8 ft. The gas is generated in two Morgan producers, measuring 5½ ft. in diameter and 10½ ft. in height. The process in the open-hearth furnace may be characterised as a Talbot process. The charge consists of molten basic pig of approximately the following composition:—Carbon, 3.5 per cent.; manganese, 1.5 per cent.; silicon, 0.6 per cent.; phosphorus, 1.82 per cent.; sulphur, 0.07 per cent.

The finished product from the open-hearth furnace is a mild steel containing 0.15 per cent. of carbon, 0.25 per cent. of manganese, traces of silicon, 0.045 per cent. of phosphorus, and 0.040 per cent. of sulphur. It is charged into the electric furnaces in the molten state. For this purpose 3½ to 5 tons of hot metal are drawn from the open-hearth furnace (which holds about 17 tons), and is replaced by a similar quantity of hot metal from the blast furnaces, the charge in the former then containing about 0.90 per cent. of carbon, 0.5 per cent. of manganese, 0.4 per cent. of phosphorus, and 0.05 per cent. of sulphur. This charge is refined in about two hours with ore, rolling-mill cinder and lime, in the usual way. By the time the ore reaction is complete, the greater portion of the phosphorus has been elminated in the slag, and nearly all the other impurities have been burned off, whereupon the slag is drawn off and a second slag is formed by fresh additions. This new slag takes up the residual impurities in the metal, and the charge is soon ready for tapping. As a rule the first slag consists of about 12 per cent. of silica, 42 per cent. of lime, 5 per cent. of magnesia, 8 per cent. of alumina, 10 per cent. of ferric oxide, 6 per cent. of manganese oxide and 14 per cent. of phosphoric anhydride. The final slag contains 10 per cent. of silica, 45 per cent. of lime, 5 per cent. of magnesia, 6 per cent. of alumina, 15 per cent. of ferrous oxide, 10 per cent. of manganese oxide, and 7 per cent. of phosphoric anhydride. The consumption of lime amounts to 14 per cent., and the added ore is about 28 per cent. of the weight of pig-iron, the yield being about the same as this latter weight. Generally speaking, no additions of manganese, spiegeleisen or ferro-silicon are required.

The *modus operandi* in the electric furnace forms a continuation of that in the open-hearth furnace. When charged with material of the above composition, the bath is refined until the samples drawn exhibit no phosphorus. This usually takes about an hour, the metal then containing, 0.05 per cent. of carbon, 0.10 per cent. of manganese, traces of silicon, and 0.04 per cent. of sulphur. The slag is then tapped, and carbon is added, the quantity depending on the hardness of the product. An amount of ferro-manganese corresponding to the desired manganese content is added at the same time. Immediately afterwards the

* E. Bian in "Stahl und Eisen."

*Table I. Chemical Analyses of Various Charges.*

| Quality | C. Per cent. | Si. Per cent. | Mn. Per cent. | S. Per cent. | P. Per cent. | Cr. Per cent. | Ni. Per cent. | Wo. Per cent. |
|---|---|---|---|---|---|---|---|---|
| Very mild, weldable | 0.04 | Trace. | 0.24 | 0.006 | 0.007 | — | — | — |
| Mild, for case-hardening | 0.18 | 0.16 | 0.62 | 0.009 | 0 009 | — | — | — |
| For engine and wagon construction | 0.45 | 0.20 | 0.62 | 0.011 | 0.008 | — | — | — |
| Do. Do. | 0.61 | 0.20 | 0.71 | 0.006 | 0.010 | — | — | — |
| Mild steel | 0.02 | 0.14 | 0.27 | 0.006 | 0.008 | — | — | — |
| Medium tool steel | 0.81 | 0.20 | 0.27 | 0.008 | 0.008 | — | — | — |
| Hard tool steel | 1.05 | 0.18 | 0.24 | 0.010 | 0.009 | — | — | — |
| Very hard steel | 1.23 | 0.20 | 0.23 | 0.008 | 0.009 | — | — | — |
| Chrome steel | 1.03 | 0.17 | 0.23 | 0.009 | 0.007 | 1.35 | — | — |
| Nickel hardening steel | 0.21 | 0.14 | 0.51 | 0.012 | 0.010 | — | 3.77 | — |
| Nickel structural steel | 0.33 | 0.20 | 0.36 | 0.009 | 0.010 | — | 3.06 | — |
| Chrome-nickel hardening steel | 0.12 | 0.20 | 0.29 | 0.011 | 0.010 | 0.91 | 3.93 | — |
| Chrome-nickel structural steel | 0.34 | 0.17 | 0.32 | 0.005 | 0.011 | 1.23 | 3.51 | — |
| Special pen steel | 0.57 | 1.53 | 0.44 | 0.004 | 0.011 | — | — | — |
| Special tungsten steel | 0.55 | 0.30 | 0.21 | Trace. | Trace. | 1.00 | — | 0.09 |

desulphurising slag is added; and as soon as this has melted, the bath and slag are deoxidised, the slag becoming perfectly white and acquiring the property of absorbing the sulphur liberated by the increased temperature. The gases and particles of slag in the metal separate out, as do also the sulphides, which are taken up by the white slag, a small portion being volatilised. In other respects the composition of the metal remains unchanged. The carbon content of the metal is determined by analysis, so that any necessary modifications may be made. For alloys steels, the alloying adjuncts are not added until after the deoxidation period, in order to prevent loss in the slag. The period in question lasts about an hour, and reduces the sulphur content to 0.005 to 0.010 per cent. When deoxidation is found to be complete, the charge is tapped, the flap doors on the platform being opened so that the ladle can be run in under the lip of the furnace. According to the purpose for which it is intended, the steel is either conveyed to the foundry by a travelling crane, or is poured into ingot moulds in the casting pit.

The foundry turns out castings of all dimensions, from a weight of 7 oz. to 10 tons, and of various qualities from a breaking strength of 51,000 to 64,000 lbs. per square inch and an elongation of 25 per cent., to 85,000 to 99,000 lbs. per square inch and an elongation of 10 to 8 per cent. For the electrical industry a special mild steel of the following composition is produced:—Carbon, 0.05 to 0.06 per cent.; silicon, traces; manganese, 0.20 per cent.; phosphorus, 0.005 per cent.; and sulphur, 0.003 per cent. The mechanical properties and chemical composition of a number of the products are given in Tables I. to III. The circumstance that electro-steel has made such rapid headway is readily explained by its excellent properties; its homogeneity, compactness of structure, purity and workability being of the first order.

There is no possibility of the bath becoming contaminated as it may in gas-fired furnaces; on the other hand the phosphorus and sulphur content can be lowered to mere traces by working the charge accordingly.

A number of tests have been made as to the capacity of electric steel to resist the action of acids and atmospheric influences, the polished test bars being immersed in separate glass flasks, fitted with hydraulic seals, and the decrease in the volume of air (corresponding to the absorption of oxygen by the metal) determined by means of a burette. The results of some other tests are given in Table IV, polished and accurately weighed bars of electro-steel, open-hearth steel and basic steel, of analogous chemical composition, being immersed in an acid liquor, and the loss in weight determined after a given lapse of time. The results indicate the excellence of electro-steel in this direction also, and that it presents decided advantages where high requirements are exacted.

*Table II. Tensile Strength.*

| No. | Elastic limit lbs. per sq. in. | Tensile strength lbs. per sq. in. | Elongation Per cent. | Contraction Per cent. |
|---|---|---|---|---|
| 1 | 31,290 | 43,400 | 35.4 | 70 0 |
| 2 | 44,090 | 69,400 | 26.5 | 54.6 |
| 3 | 61,150 | 96,600 | 20.2 | 42.0 |
| 4 | 70,260 | 114,350 | 15.0 | 35.6 |
| 10 | 54,600 | 76,080 | 24.5 | 64.0 |
| 11 | 65,140 | 86,750 | 21.9 | 50.0 |
| 12 | 64,570 | 83,910 | 22.3 | 64.0 |
| 13 | 104,680 | 123,740 | 13.3 | 48.0 |
| 14 | 68,270 | 112,640 | 15.2 | 43.0 |

TABLE III.—*Results on Annealed Castings.*

| No. of Charge. | C. Per cent. | Si. Per cent. | Mn. Per cent. | S. Per cent. | P. Per cent. | Tensile strength. lbs. per in. | Elongation. Per cent. |
|---|---|---|---|---|---|---|---|
| 385 | 0.12 | 0.13 | 0.53 | 0.014 | 0.011 | 51,920 | 22.5 |
| 368 | 0.10 | 0.20 | 0.48 | 0.015 | 0.020 | 58 030 | 23.5 |
| 704 | 0.23 | 0.30 | 0.59 | 0.021 | 0.025 | 66,850 | 24.0 |
| 705 | 0.26 | 0.31 | 0.62 | 0.018 | 0.022 | 68,550 | 20.0 |
| 707 | 0.32 | 0.35 | 0.83 | 0.012 | 0.025 | 79 650 | 20.5 |
| 734 | 0.35 | 0.32 | 0 68 | 0.022 | 0.023 | 85,330 | 15.5 |
| 816 | 0.37 | 0.35 | 0.71 | 0.009 | 0.017 | 95,240 | 15.0 |

TABLE IV.—*Resistance of various Steels to Acid.*

| | Steel. | Loss in weight after 4 days. | After 7 days. |
|---|---|---|---|
| | | Per cent. | Per cent. |
| I. In hydrochloric acid solution | Electric | 2.71 | 4.50 |
| | Open-hearth | 4.62 | 6.67 |
| | Basic Bessemer | 13.82 | 21.30 |
| II. „ „ „ | Electric | 1.31 | 3.50 |
| | Open-hearth | 2.98 | 5.00 |
| | Basic Bessemer | 6.47 | 12.90 |
| III. „ „ „ | Electric | 1.53 | 3.00 |
| | Open-hearth | 3 70 | 6.92 |
| | Basic Bessemer | 6.00 | 11.62 |
| IV. In sulphuric acid solution | Electric | 3.73 | 7.21 |
| | Open-hearth | 8.41 | 16.76 |
| | Basic Bessemer | 13.86 | 24.73 |

We have received from the Anglo-American Oil Company, Limited, 36-38, Queen Anne's Gate, Westminster, S.W., an interesting booklet on "Liquid Fuel," calling attention to the great field offered for the application of liquid fuel in various smelting, enamelling, and metallurgical processes, in addition to its value for steam-raising and marine purposes.

# Unevenly Chilled and Untrue Car Wheels.*

By Thomas D. West.

It is generally known by those familiar with the manufacture and use of chilled car wheels that only a very small percentage of them are evenly chilled. The writer was informed by Dr. C. B. Dudley, that in the examination of a large number of broken wheels at Altoona fully 70 per cent. showed variations in the depth of chill. Unfortunately for the railroads, the evenness of chill around wheels is a quality which defies inspection. An uneven depth of chill around car wheels is a serious evil. It weakens a wheel just as similar defects weaken chilled rolls, and rolls often snap in two under loads that would have had little effect on them were they chilled to an even depth. The chief cause of this weakness lies in the great difference in strength and contraction of the same iron when in a grey state and in the chilled form.

First, as to the question of strength. Of two casts from the same ladle, the one grey and the other chilled or of an all-white fracture, which means that the carbon is almost entirely in the combined form, the latter generally possesses but little over half the strength of the former. The strength of the white or chilled iron varies according to the class of iron used, that coming from a burnt or oxidised iron being the weakest, and that from charcoal iron the strongest. As far as the strength is concerned, therefore, compelling the iron to take the white or chilled form is a necessary evil and often a serious one, especially if the depth of chill is uneven, as it is in the great majority of car wheels cast to-day.

Secondly, in considering the relative contraction of chilled and grey iron cast from the same ladle of metal, we find that the former contracts about as much again as the latter in metals such as Nos. 4 and 5, Table. I. The bars used by the writer in making these tests were about 1½ in. square by 24 in. long. Fig. 1 shows the plan of moulds used; the sand bars were cast in the space P and the chilled bars in N. The one sand cope covered both moulds; each mould had a gate at the centre, and was poured from the same basin.

TABLE I.—*Contraction Tests of Chilled and Grey Iron. (Test bars, 1½ in. square by 24 in. long.)*

| Heat No. | Character of Metal Tested. | Contraction of Chilled Iron. | Contraction of Grey Iron. |
|---|---|---|---|
| | | Inches. | Inches. |
| 1 | Ferro-silicon ... ... ... | 0.270 | 0.240 |
| 2 | Foundry iron ... ... ... | 0.262 | 0.205 |
| 3 | Bessemer iron ... ... ... | 0.271 | 0.211 |
| 4 | Gray iron with 15 per cent. steel ... ... ... ... | 0.322 | 0.227 |
| 5 | Charcoal iron ... ... ... | 0.446 | 0.229 |

If it were not for the fact that the chilled crust of a car wheel or other casting obtains considerable of its contraction before the body of grey iron, which is generally in a liquid state after the chilled crust has solidified, it would be a hazardous undertaking to make any casting having a chilled crust and grey interior. Nevertheless, owing to the difference of contraction mentioned above, there must exist greater internal stresses in a chilled car wheel than if the same casting of grey iron were cooled under normal conditions.

The writer is convinced that the present methods of casting are responsible for not only unevenly chilled, but also for untruly round car wheels. Recognising the importance of tests on the roundness of tread of chilled car wheels, he succeeded in obtaining data upon such tests through the courtesies of Mr. S. K. Dickerson, Assistant Superintendent of Motive Power, and Mr. H. E. Smith, Engineer of Tests, of the Lake Shore and Michigan Southern Railway Company.

To make these tests six pairs of wheels cast by different founders were selected. An axle with a wheel pressed on each end was placed in a lathe, and the centres were firmly pressed. The wheels were then hand-turned. This done, the tread was divided into eight sections, each the same distance from the flat edge, and a specially constructed micrometer used to discover any variation in the roundness. All the testing was done with great care and precision.

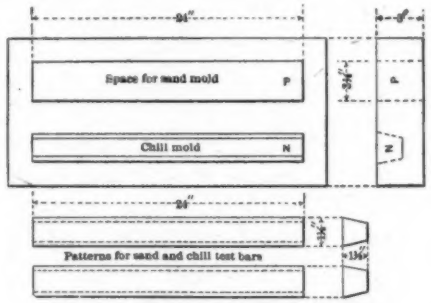


FIG. 1.—SAND AND CHILL MOULDS.

The tests are illustrated in Fig. 2. The dotted line in each diagram is a circle through that point on the tread having the smallest radius, and is considered as the datum line. In plotting the diagram, the variations from this datum line have been multiplied by five, in order to emphasise the irregularity of the tread. It is to be understood, however, that the figures given are the actual variations in the radii of the wheels from the datum circle.

The results of a majority of these tests certainly demonstrate the necessity of improvement in the roundness of wheels as well as obtaining an even depth of chill, and show the importance of testing the roundness of car wheels. The writer is not aware of any regular tests of this kind being made by the railroads, but believes that if they were made with the present make of wheels, only a very small percentage would pass satisfactorily. Such tests could readily and cheaply be made before the wheels are bored by setting an internally-turned iron ring over the tread. There are, of course, other plans which could be used, but the ring should answer the purpose in many cases.

While the wheels are undoubtedly weakened by the uneven depth of chill and have therefore a shorter life, their lack of roundness also prevents smooth running and must cause some vibration or pounding which greatly aids in creating fractures or breaks in

* From the Proceedings of the American Society for Testing Materials.

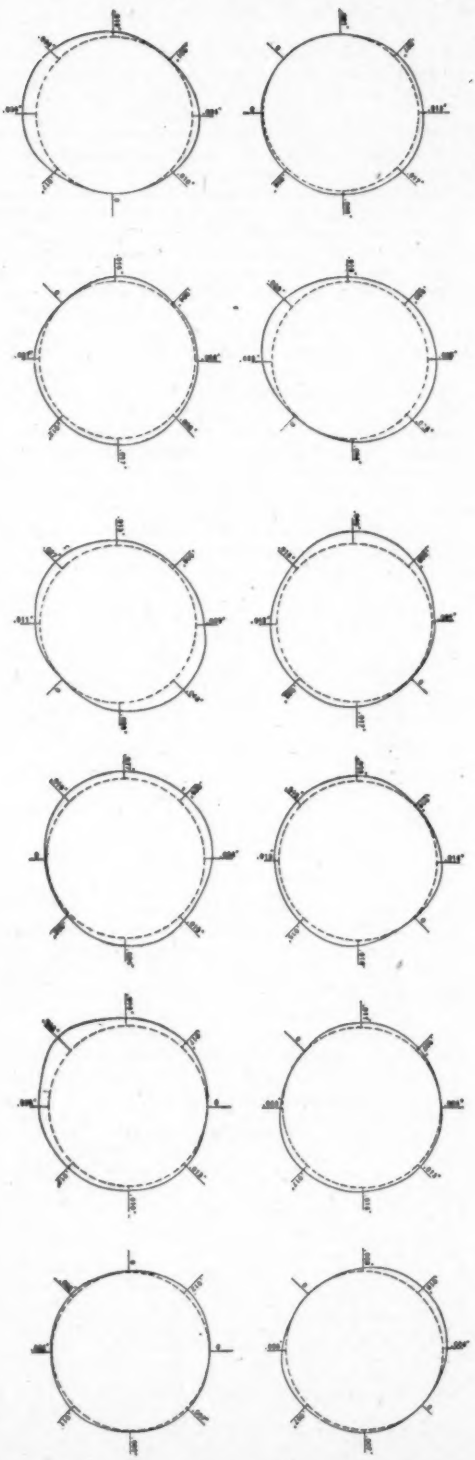

FIG. 2.—IRREGULARITY IN THE ROUNDNESS OF CHILLED CAR WHEELS.

the rails. This pounding effect of flat wheels has been accurately and scientifically demonstrated.

The longer any chilled body remains in contact with the chiller, the deeper chill will it possess. Therefore, any factor which tends to prevent the chilled crust from contracting away evenly from the surface of the chiller is a cause of unevenly chilled castings, and also serves to aid the making of untrue wheels.

The writer has, after much study, devised a method of casting which will assure evenly chilled and truly

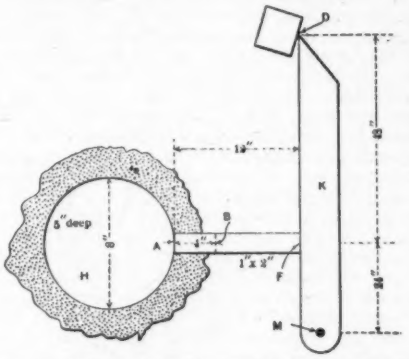


FIG. 3.—EXPANSION TEST FOR CONTRACTION COMPRESSION ARMS.

round car wheels. (See "The Iron Age," Aug. 5, 1909.) Since the publication of this article, the writer has made improvements which allow the outer edge of the flange to be of the form now required by the Master Car Builders' Specifications. This change permits railroads obtaining wheels cast by this method to meet their specifications for form in every respect.

The thermal and drop tests to which chilled car wheels are now subjected define in a measure what

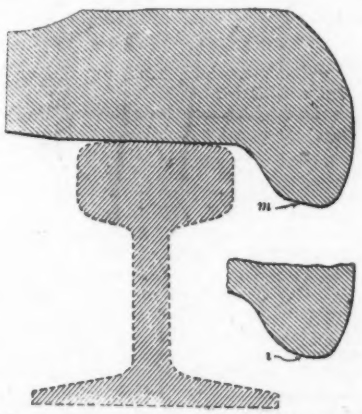


FIG. 4.—ILLUSTRATING WHEEL FLANGES.

qualifications any special lot of ninety-nine or ninety-eight wheels must possess, but is not the present uncertainty of obtaining an even depth of chill one that could often shake faith in the accepted lot? It is therefore essential to know positively just what any method advancing a remedy for these defects wi.. accomplish.

In the past year the writer has done considerable experimenting with his improved method, the results of which have demonstrated the urgent need of having the chilled crust uniformly "hugged" during its

contraction. Those familiar with the manufacture of chilled car wheels know that much study has been devoted to the idea of obtaining what has now been achieved by the writer, and that several different methods have been tried to attain these ends. These methods depend upon the expansion of short arms which are a solid part of the chiller. To see how far these arms will tightly follow up the contracting shell, the writer presents the test illustrated by Fig. 3. A 1-in. by 2-in wrought-iron bar 12 in. long has one end A exposed to the heating influence of liquid metal poured into a basin H, 8 in. in diameter by 5 in. deep. The other end F is in contact with a 1-in. board K, which is free to swing about the fulcrum M at one end, while the other end just touches a block at D. A test of this device showed that in five minutes after pouring metal to fill the basin, two fingers could be tightly held on the bar at B, 4 in. from the edge of the basin. It required ten minutes before light could be seen through the opening at D, and fifteen minutes to note any heat to reach the end at F.

In a study of this test for purposes of comparison, it is to be remembered that the arm or bar A is fully two-thirds the length of those forming a solid part of the so-called compression chiller. Another point to be kept in mind is that any form of arm devised to obtain a tight hugging contact with the contracting crust, as is done in a positive manner with the writer's method, must expand or be forced inward fully 3-16 in.

Another fact which was brought out in the writer's experiments, and one which he believes is known or fully realised by very few, if any, experienced car wheel makers, is that the chiller will expand about ¼ in. in diameter after pouring the metal. Here we have a movement which is the opposite of contraction and which, in the case of the compression chiller, serves to pull the arms back from the contracting crust more than their expansion can force them inward. This evidently defeats the purpose of having arms tightly hugging the contracting crust, which is necessary to obtain an even depth of chill and true roundness in wheels.

To those who are familiar with the manufacture of car wheels, the importance of the above comparisons is self-evident.

The recent experiments of the writer tender every assurance of his method giving evenly chilled and truly round car wheels. This improvement should wrought iron or steel wheels, comments on the value greatly encourage the continued use of chilled wheels, no matter what proficiency may be obtained by wrought iron or steel wheels.

### The West Process.*

To demonstrate the practicability of the appliances used with the improved process seen in Figs. 5 and 6, a few wheels were cast at the Standard Car Wheel Company, Cleveland, Ohio. It was discovered that the chill or crust contracted about ¾ in. inside of 7 minutes. This means that the outer or chilled rim of a car wheel contracts nearly its full amount, while much of the internal body is still semi-liquid.

The writer's remedy for uneven chill is to cause the wheel while contracting to remain central in the mould, so that one part will not remain in contact with the chiller longer than any other. To accomplish this he uses the outer edge of a wheel's flange in connection with the top edge of the wheel's tread. As the latter may be considered unnecessary by many, it is not shown here. How the flange is utilised to obtain the ends sought will be seen from Figs. 4, 5 and 6. The centraliser *p* is of solid iron and of sufficient weight, so that when released by pulling out the keys *r* it will descend by gravity as fast as the contracting crust will permit it, and compel the casting to leave the surface of the chiller uniformly. Thus there is obtained an even depth of chill and a true round wheel.

Fig. 4 is shown for the purpose of illustrating, as at *n*, the form of the outer edge of car wheel flanges in use at the present time. At *m*, is the form used by the writer's process, and while it is slightly different, no objections have been presented to its use.

A chill will be deeper in a casting the longer the surface of the metal remains in close contact with the chiller, up to the limit of the possible effect of the chiller. If there is any other reason for an uneven depth of chill in wheels than that some part of the casting's surface becomes freed from the chiller sooner than another the writer does not know of it, nor has he heard any other explanation.

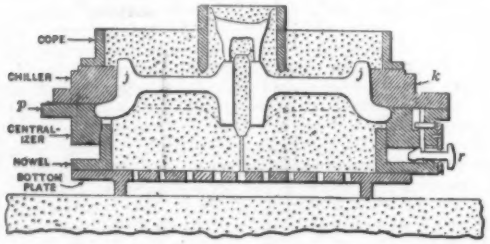


FIG. 5.—MOULD JUST AFTER BEING POURED.

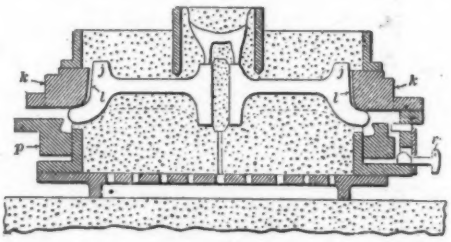


FIG. 6.—MOULD SEVEN MINUTES AFTER BEING POURED.

THE WEST PROCESS FOR CASTING CAR WHEELS.

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### Glass as a Brass-Foundry Flux.

The question is still being asked, "Is glass a good flux for brass," and many foundrymen still favour it. It is actually not a flux, but a protective covering which has no fluxing effect on the metal at all. The reason why it apparently serves the purpose is that it melts to a viscid mass on the top of the metal and prevents it coming into contact with the furnace gases and air. Hence, the oxidation troubles that otherwise might be experienced are avoided. But if dirty and oxidised metal is used in the furnace, glass does not clean it. At the same time, there are still a number of good brassfounders who melt quite successfully and use only glass as a protective covering. All the scrap from the foundry, gates, sprues, risers, chippings, etc., are put back into the crucible for re-melting without the use of deoxidisers, the glass being apparently quite sufficient to meet the case. It is best, however, when melting such miscellaneous scrap to use salt as a flux, as it assists in avoiding the troubles associated with dirty metal.

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* To elucidate the foregoing references, we append the following Abstract from "The Iron Age," August 5, 1909.

# Japanese Bronze Castings.

In comparing modern European art with that of foreign countries and of ancient times, says H. Heiland in the "Giesserei-Zeitung," it is found that in the department of metal working, even among the ancient Egyptians, but very little use was made of the foundry art. The single exception which proves that outside of Europe the founder's art has existed for thousands of years is given by Japan and the related land of China. It must be conceded that the knowledge of this art, and especially that of bronze casting, took its course from China to the younger land of Japan. There, however, it attained a higher degree of development, although it soon took an almost bizarre direction, and swerved more and more from the ancient Chinese classic style.

Whether or not the art of casting was the same in the old days in Japan as now, is difficult to ascertain. But the Japanese are in all such things so conservative—as much so as the Chinese—that it may be assumed to be so. As far as we can judge from the products of those times which have come down to us, bronze casting reached its highest point there in the eighth to the twelfth century. The most important of these, at least as far as concerns large castings, are the two world-renowned statues of Daiboots at Nara and Kamagura.

Japanese casting then, as at present, had two special features—modelling in wax, and casting in many pieces. In observing a Japanese casting very closely, no matter how small it is, even an expert would at once be of the opinion that he had before him a one-piece casting—but he would be mistaken. Such division of the casting as the Japanese carry out is unknown to us. It is connected with the almost exclusive use of wax patterns. In this joining of castings the Japanese perform wonders. Even those mighty bronze figures, the Daiboots, are made up of a great number of different plates. But these are joined together in so exact a manner that it has taken centuries to reveal the seams to us. And even to-day one can often not say with certainty if this or that part is a single casting or built up.

The two large figures, the Daiboots, are, from the technical standpoint, very interesting. Happily, the old Japanese historians report very minutely just how the statue at Nara was made. It consists of bronze plates about 10 by 15.6 in., and 6 to 10 in. thick. The newer portions of the statue are of very much larger pieces, and the head, which was cast in the 16th century, but from the artistic standpoint is much inferior to the other portions, appears to be in but one piece. The separate parts of the entire statue are hard-soldered, a technical achievement of which the historians give an explanation. The parts were cast one after another, and while one piece was cooling, the mould for the adjacent piece was made above or beside it, so that most probably the separate parts were simply in this way set together, and the molten metal was let flow directly on the partly-cooled piece previously cast. In this manner, which is still practised in Japan in another way, there resulted, naturally, a very rough and faulty surface; and it required the well-known Japanese patience and the (at that time) very low wages of the workmen to remove all these faults with chisel and scraper, and to give the surface the mirror-like appearance which it even yet shows.

The manner of working in the Japanese foundries, of which the largest and greatest number are in Osaka, is as follows:—Instead of moulding-sand, they employ an exceedingly fine kind of black river mud. This mud is mixed with a mass obtained by hammering the toughest Japanese paper in a wet condition to a pulp. This forms the first layer that is laid over the pattern or model. After this follow layers of coarser material; and the outer layer is made up of a moulding-loam much like ours, mixed with rice straw.

As a rule, the Japanese use wax models or patterns. For this reason they lose the original every time. Here we have to take account of two separate arts or trades. Usually, there is made for every casting a new wax model or pattern, for which reason even the more simple Japanese bronze castings have individual characteristics. An exception to this is in the main made only in respect to the statues of their gods, which in their quite stylistic character must adhere exactly to the old forms. For this reason the large foundries take pride in their wooden models of the gods, some of which models are of enormous size, and sometimes hundreds of years old.

When the foundry receives an order to cast a statue from one of the old patterns or models, the first thing done is to build up in the level earth, or in a casting pit, the core, which as far as possible, corresponds to the outer form of the statute that is to be. Then sectional casts of the various portions of the wooden model are made, and laid over the core; the toughness of the material rendering this process comparatively easy. About the resulting wax pattern, that as a rule is surprisingly thin in comparison with the size of the entire figure, there is built the "mantel," the inner layer of which consists of the above-mentioned mud. In building this up, care must be taken to make channels from all sack-like portions of the model, so that the wax can flow off therefrom. In order to give the statue—and especially if it be a standing figure—sufficient resistance to the pressure of the molten metal, the entire mantel is held together by a framework, wound about with rice straw. Straw ropes are also built into the mantel itself.

The mold remains in place, or is let down by the crane into the pouring pit, where it is dried. When sufficiently dry, the entire mould is heated from below upwards by filling the pit, a layer at a time, with some non-flaming fuel, as wood charcoal. This process naturally melts the lower portions of the wax model or core first, so that room is left for the upper portions to flow out when they are melted. It is generally typical of the Japanese bronze casting, that they are poured in a hot, and even almost glowing, mould. It is this only which seems to enable them to secure, even with large and unfavourably-shaped articles, such thin walls.

The metal is melted in a very singular manner. The Japanese has no fixed melting furnace; he builds about the crucible a sort of shaft of fire-clay, or a series of stone rings—sometimes even of ordinary clay—in which the fuel is piled up around the crucible. This method has the great advantage that these improvised furnaces can be made of the proper size to suit the crucible. Just as singular is the blowing apparatus, which, from the technical standpoint, is much better than our simple bellows. It consists of a cylinder with flap valves on two sides, and in this vessel, which is sometimes round and sometimes prism-shaped, there is a piston moved by an axial piston-rod, so that the entire apparatus is a double-acting air-pump. The piston-rod comes out through

the cover, has a cross-piece, so that rod and piston can be worked to and fro by one or more workmen. This blowing apparatus, which may or may not have an air chamber, delivers an almost continuous air current of considerable volume, so that the melting of the metal takes place in an astonishingly short time.

The above-described process of working from a model or pattern already on hand is now, as before said, exceptional in Japan. As a rule, for each article an absolutely new pattern or model is made of wax, in the following manner:—The greater part of the Japanese bronze castings are hollow, and generally in the form of vessels. At first the wax modeller takes a tube or rod, lays this across two supports, and makes on this, with clay mixed with rice-straw, the core, which here, also, as nearly as possible, approaches the form of the desired casting. This core is dried; and then the wax modelling begins. In large vessels filled with hot water there swim lumps of wax of various sizes; these are rolled out on a flat board by means of a plate or a roller. In the same manner there are also formed strips, which materially lighten the work of the modeller. When the core is dry enough, he cuts the wax slabs in sufficiently large pieces, and covers the core with them in such manner that thin shells come where the wall of the casting is to be thin, and thick slabs where it is to be thick. All unevennesses of the wax are smoothed out with wooden rods and spatulas, so that soon the smooth form of the object to be cast is attained. In this condition another workman, who must be more or less of an artist, takes the half-ready wax model, and thereon moulds in wax the various flowers, dragons' figures, and other decorations which the casting is to bear. The skill of the modeller in his work is really astonishing. Of course, the design being so often repeated, it is no trifle to model, the most frequently recurring figures being of the "rio," or Japanese dragon, in ever-new bizarre poses.

When the entire wax model, or that of one of the parts out of which the casting is to be made up, is ready, and the wax sufficiently hard, the inner rod is removed, and now with the brush there is laid on a thin layer of almost liquid moulding-clay, reaching into the finest depressions. This first layer is let dry; then a second and a third are laid on, and so on, the mould-maker being careful to press into the mass pieces of sand from an old mould, which absorb water readily, in order to take up any excess of water. So layer after layer is laid on, using coarser and coarser moulding material in turn, until at last the ordinary moulding loam, as first described, completes the work. The finished mould is then dried, and about it is built the same kind of temporary furnace as is above described, and which is filled with fuel in order to melt out the wax.

The most remarkable thing about the entire Japanese foundry practice is the appearance of the casting when it comes out of the mould. If a European founder were to show his employer such a casting, the entire "commercial court" would not be able to save him from discharge without notice. The casting seems to consist principally of holes. The reason for this is the remarkable thinness of the walls, making a complete filling of the mould an absolute impossibility. The Japanese moulder has an almost unexampled dexterity in building over such (often very large) holes improvised moulds, sometimes employing wax patterns. Then there is melted in a crucible bronze of the same colour, and this is poured in these moulds; and the Japanese understands most thoroughly how to weld the patches in completely. How such a casting looks after such a weld-patching has taken place in 50 or 100 places can well be imagined. Now begins the real work—that of cleaning up. Here the Japanese founder seldom uses the file, his tools being nearly always scraper and chisel. But the steadily-rising rates of wages in Japan will very soon render this kind of work impossible.

When a casting has left this part of the establishment, it has a wonderful polish, and there is hardly a seam or a fault to be seen. The last work which is done upon it is the colouring; in this the Japanese are justly renowned. We have already learned much from them, although many secrets are still jealously guarded by them.

## A Solder for Aluminium.

By the use of "S.A.L." aluminium solder, it is claimed that aluminium can be soldered as easily as tinplate. No flux is required with this solder, but it is essential that the surfaces should be well cleaned. Petrol may be used to remove grease, but in all cases the final cleaning should be done mechanically, either with a file, scraper, emery cloth, or best of all, with a wire brush. The article to be soldered should be heated to the temperature at which the solder melts (about 300 C.) by any suitable means, a blow-pipe flame, Bunsen burner, or soldering iron. Care should be taken that any flame used is free from carbon. The soldering iron is useless for heavy articles, on account of the great capacity for heat of aluminium. The flame should not impinge more than necessarily upon the solder, but should be directed rather upon the metal being soldered. For "tinning" the parts to be joined, the stick of solder is rubbed on the already heated aluminium until it melts, then with a wire brush the solder is worked well into the metal. This at the same time helps to remove any oxide or grease which may have formed. A little fresh solder is then applied and the surfaces are pressed into contact. The joint is heated again to melt the solder, and allowed to cool. All joints should, if possible, be kept under pressure until thoroughly set.

In soldering aluminium to any other metal the latter is "tinned" in the usual way with ordinary tinmen's solder, and any flux used is washed off. The joint is then soldered with "S.A.L." aluminium solder in the usual way. For repairing broken aluminium castings, the surfaces of the broken parts are carefully cleaned with petrol to remove all traces of grease. The parts to be joined are secured with cramps in such a way that they can be readily dealt with while hot, taking care there are means of tightening the joint as soldering takes place. The parts are then separated and heated by means of a paraffin blow lamp or Bunsen burner, until upon rubbing a stick of solder upon the surfaces melting takes place and the solder adheres. The surfaces are rubbed with a wire brush until the solder adheres all over, the excess of solder is removed, and a small portion of fresh solder is melted on the "tinned" surfaces. The parts are placed together, the cramps replaced, and the flame directed upon the joint until the solder melts again. The cramps are then screwed up and the casting allowed to cool.

For repairing cracked aluminium castings a groove is filed or chipped along the crack, and all oily matter washed away by means of petrol. The groove is heated and tinned as above and finally filled with molten solder.

A soldering iron may be used for thin sheet aluminium, and if a gas-heated soldering iron of good dimensions is used even thick sheet aluminium can be soldered well. The blow-flame lamp of the Bunsen burner may be used also. The "S.A.L." solder is made by the Standard Alloys, Limited, 7, Victoria Street, Westminster, S.W.

# Cast Iron Pipe Moulding.

Writing in a recent issue of the "Iron Age" Mr. R. Ardelt discusses the merits and demerits of the new continuous system recently introduced into the pipe foundry at Coshocton, Ohio, belonging to James B. Clow & Sons, Chicago. This pipe foundry uses a new continuous principle brought out by Mr. Fred Herbert, which is supposed to represent an improvement over the continuous turntable system.

In comparing the circular with the rectangular system, the writer refers to the Ardelt continuous moulding and casting plant, with turntables and ramming machines, as supplied by R. Ardelt & Sons, Eberswalde, Germany. The Ardelt truntable system is illustrated in the acompanying illustration, Fig. 1. At each turntable, to which the flasks are

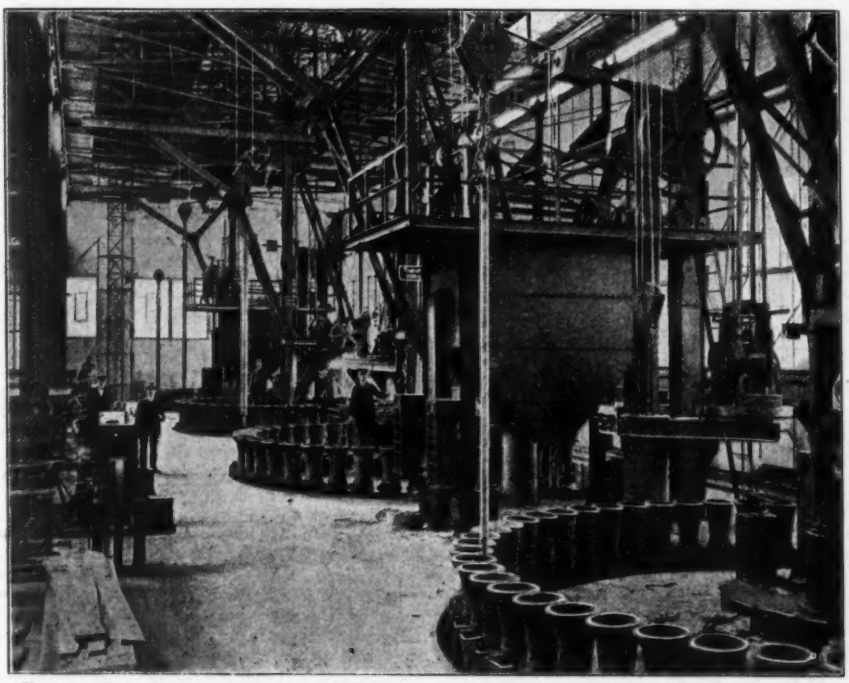

FIG. 1.—THE ARDELT CONTINUOUS TURNTABLE SYSTEM OF MOULDING CAST-IRON PIPES.

firmly connected, two core drying ovens with core lathes for making the main pipe cores are arranged in such a manner that the cores will be lifted by the three-motor electric jib crane standing in the centre of the turntable directly from the drying oven cars and set into the moulds. In the same manner the core bars pulled from the moulds are returned, without the need of any intermediate means of industrial cars. The ramming machine at each turntable is practically continuously at work, as a separate electric winch is employed for setting and drawing the main patterns. The molten iron is carried by means of a travelling bracket crane, which travels the length of the building and transfers the iron to the jib crane on the turntable for casting. The moulds are cast on a turntable eight times in 10 hours, and each time only one-half of the flasks attached to the turntable are cast, so that each flask is used four times in 10 hours and each core bar twice.

Between each two turntables a sand tempering and preparing apparatus, with a sand bin which holds a sufficient stock, is always provided. The pipes are shaken out close to the elevator of the preparing apparatus, so that the sand after being moistened will be immediately delivered into the bins without any intermediate handling, and falls from the bin directly to the place where it will be shovelled into the flasks.

With eight men at the turntable, four men at the core lathes and one man for making the socket cores—a total of 13 men—the crane man in such a plant will put out 250 pipes of 80 mm. (3½ in.) inside diameter and 3,500 mm. (11½ ft.) in length in 10 hours, which is one man for more than 19 pipes.

Those familiar with the operation of a pipe foundry know that, in consequence of the extremely dusty and rough work, the greatest simplicity must be observed, both in the construction of the moulding devices and in other equipment, if subsequent high maintenance costs and expensive stoppages of work are to be avoided. The moulding apparatus parts which have to be frequently taken off should be secured by cotter pins instead of screws, and all rollers and turning and friction parts should be avoided as far as possible.

Before erecting the Coshocton foundry, an engineer who made an investigation of all the American and European continuous systems of cast-iron pipe manufacture considered the turntable circular system as unsuited for a continuous service, and, therefore, selected the straight line system as safer and more suitable. Mr. Ardelt endeavours to show that the Herbert row method by no means offers any advantages over the older approved circular method with an up-to-date turntable, as designed by an experienced foundry engineer and properly constructed. This, he contends, is the safest machine that can be devised. Stoppages with such a turntable are practically out

of the question. The necessary strength of these tables may be easily obtained by a suitable design. On such a turntable pipes of an inside diameter up to 5 ft. can be made, for which purposes a pressure up to 80,000 kg. (85 tons) is employed for drawing the shaft patterns.

The flasks are longitudinally divided in two sections, one of which is fitted by screws to the turntable and rotates with it. The driving is effected by an electric motor of 4 to 6 h.p. The ramming machine

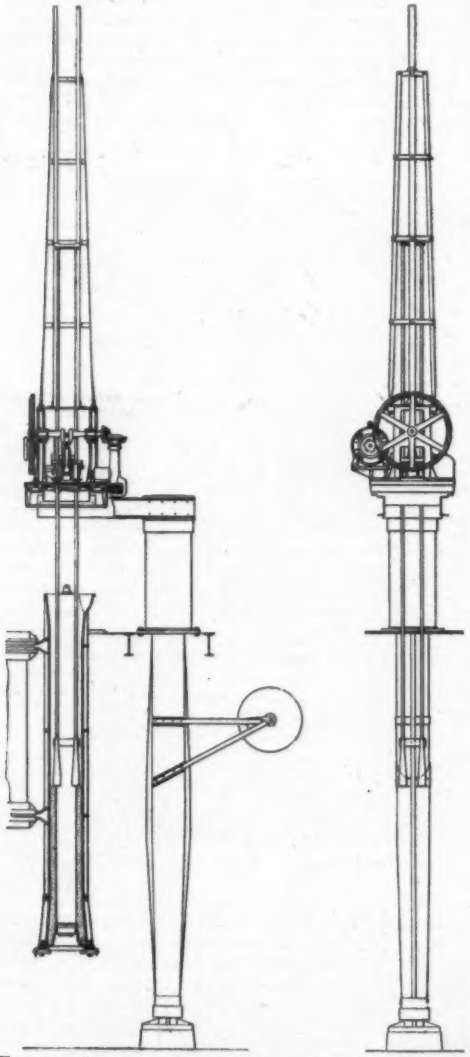

FIG. 2.—ARDELT PIPE-MOULD RAMMING MACHINE.

is mounted on a swinging bracket, which is secured to a pillar standing outside of the turntable, as shown in section in Fig. 2. The swinging bracket permits the ramming machine to be rapidly centred over the main pattern in the flask; four rammer rods for large sizes of pipes and six to eight for smaller ones will be lowered and raised in ramming the sand at a speed of 120 to 160 strokes a minute until the mould is made. Then the pattern is withdrawn, the turntable revolves till the next flask is in position, the pattern is set in, the machine swung over, and the ramming of the next mould is proceeded with. A few flasks further the mould is blackened, then the moulds pass over the drying gas burners, and when sufficiently dried the cores are set in and the moulds are ready to be poured. After a short time for cooling, the core bars are pulled, the casting is shaken out and the flasks are ready for further use.

The ramming only must be done at a given spot, owing to the ramming machine and the pattern winch above it. It is of no importance where the other operations are done, as the jib crane in the centre of the turntable can reach any point. The objection raised that by a delay at any point the progress of the work on the turntable may be impaired, therefore, does not hold good with regard to the method here described.

The circular travel of the flasks, contends the writer, remains undoubtedly the most proper in all respects for a continuous method; it is impossible to find sufficient reasons based on the impracticability of the turntable system to justify leaving this line of travel and converting it into that of following the sides of a rectangle. He is confident that the reason for constructing the continuous row system lies solely in the desire to be able to use the hydraulic pipe moulding machine. This machine demands, or at least it is very advisable, that the flasks be attached to the base of the moulding machine to enable it to withstand safely the great force with which the pattern is forced into the sand, and avoid a vertical displacement of the flask. If the flasks should be secured to a turntable the use of such a machine would be practically out of the question.

In order to use this machine the simple, safe turntable has been discarded, the easily obtained circular travel of the flasks has been dispensed with and a more complicated travel in rectangular lines has been adopted. And how many more constructional parts, which in such a pipe foundry are subject to constant repair, will be required? Each flask is fitted with four rollers, which must be kept in use; with 144 flasks this means 576 rollers. The ways for the flasks must be kept in perfect order, as otherwise the movement of the flasks will be obstructed and the working of the plant impeded. For the longitudinal movement of the flasks four hydraulic pushers, and for the transverse movement two transfer cars, also operated by hydraulic rams, are required. The operation of all these apparatus is extremely tedious and wastes much time, as they are too distant from the points of work. (Each flask is used in 10 hours not more than two and one-half times.)

The Herbert system offers advantages with regard to neither simplicity nor safety in working over the turntable system, and still less with regard to cost of attendance and maintenance. The core drying ovens lie so far from the casting shope that each core must be delivered to the latter on cars, which is another disadvantage of this system.

With regard to the pipe moulding machine, concludes the writer, the objection may be raised that a pattern-drawing machine requires high power for forcing the pattern through, therefore the flasks must be made very strong and heavy. With large moulds it will be practically impossible to make them in such a manner. The wear on the patterns is also very severe, as they are under a very great superficial pressure through the sand. Therefore, it will be exceedingly difficult to maintain the standard weights of the pipes, as the core-maker is not permitted to make the cores smaller so as to correspond with the constantly diminishing outer diameter of the pipes. Furthermore, it will be difficult to maintain the standard diameter sizes. Also, the machine works too slowly. Each flask must be first attached to the

machine; after the flask has been centred a measuring tube is lowered through, then the sand is filled in, and only then can the machine operate. With the Ardelt ramming machines the mould is finished in the same time in which the sand is filled in. It, therefore, works considerably faster. There is no need of securing the flasks to the machine and detaching them again after ramming.

## Titanium for Malleable Iron.*

By C. H. Gale.

In order to learn what good might result from ferro-titanium if added to malleable iron, the writer made a series of tests, the first series being made with ferro-titanium additions to the ladle. The alloy was supposed to contain about 10 per cent. titanium; in reality, however, it ran higher, or about 17 per cent. As this condition resulted in an increased difficulty in melting the alloy, particularly where the larger quantities were used, considerably less of the alloy was actually taken up than the calculated quantities would indicate.

Three hand ladles containing about 40 lbs. of iron each were taken from the very early part of a 15-ton heat made in the open-hearth furnace, the heat being the second one of that day. The first ladle was held without any titanium alloy addition. To the second ladle there was added sufficient alloy to introduce 0.125 titanium into the iron. To the third ladle double this amount was added. After stirring the second and third ladles to get as much as possible of the alloy in solution, the contents of the three ladles was poured into three moulds. It will be noted that the third ladle was the coldest of the three. In consequence of this it was not surprising that the heavy sprue in this case was nearly grey in fracture, the second mottled and the first dead white. The analysis of the metal was as follows:—Sil., 0.66; sul., 0.046; phos., 0.175; mang., 0.36; C. C., 2,66; graphite, trace. None of the bars to which titanium had been added showed the slightest trace of this element on analysis. While the sprues indicated the precipitation of graphite as the titanium additions arose, the bars themselves should not have done so for the analysis given. A second set of ladles treated in exactly the same manner was taken from near the end of the heat and gave the same indications.

Each mould contained two test bars, one round bar for tensile tests, varying from 0.614 to 0.637 in. in diameter for the lot cast, this dimension being at the middle of the bar where the diameter was the smallest. With this bar was cast another one for transverse tests ½ by 1 in. in section and 14 in. long. The following are the results:—

*Average of Tensile Tests of Malleable Iron with Titanium Treatment.*

| Ultimate Strength. Lbs. per sq. in. | Elongation in 2 in. Per cent. | Titanium added. |
|---|---|---|
| FIRST PART OF HEAT. | | |
| 49,717 | 6 | None |
| 46,481 | 3.4 | 0.125 |
| 42,800 | 2.9 | 0.250 |
| LAST PART OF HEAT. | | |
| 48,368 | 6.2 | None |
| 43,452 | 2.3 | 0.125 |
| 45,294 | 3.1 | 0.250 |

The considerable cooling of the metal by the alloy addition in the ladle practically spoiled the test bars with high titanium additions, the metal not being able to clear itself from slag and dirt. Yet it was noticed that even with a bar flawed to one quarter of its cross section, an astonishingly high ultimate strength was attained. Similarly the presence of dirt and flaws affected the elongation, actually cutting this off abruptly. Hence the figures are quite low.

Considering the above, definite conclusion cannot be drawn from the tensile test results so far as the action of titanium on malleable is concerned. Further, a glance at the figures obtained for the regular metal without titanium additions shows the improbability of serious oxidation influences that could have been corrected by the titanium additions. Trying this with cupola metal would have been another story.

The transverse tests gave the following results:—

*Average Results of Transverse Tests.*

| Broke, lb. per sq. in. | Deflection in inches. | Titanium added. |
|---|---|---|
| FIRST PART OF HEAT. | | |
| *1,380 | 1.80 plus | 0.125 |
| 1,270 | 1.62 | " |
| *1,370 | 1.80 plus | " |
| Average 1,315 | Average 1.74 | |
| 1,142 | 0.83 | None |
| 1,162 | 0.72 | 0.250 |
| LAST PART OF HEAT. | | |
| 1,213 | 1.24 | None |
| 1,260 | 1.40 | 0.125 |
| *1,320 | 1.80 plus | " |
| 1,290 | 1.68 | " |
| Average 1,290 | Average 1.62 | |
| 1,030 | 0.58 | 0.250 |
| *1,310 | 1.80 plus | " |
| 1,340 | 1.32 | " |
| Average 1,227 | Average 1.23 | |

* Beyond the range of the machine, so far as deflection was concerned; the test pieces in these cases were not broken.

The next series of tests was to observe the effects of titanium in "malleable" when added to the bath of molten metal. The alloy was added after the charge had melted down and the slag had been skimmed; that is, about 30 to 45 min. before tapping the 10-ton afternoon heat of an open-hearth furnace. The percentage of titanium added to the second series of tests was much less than in the first. Here also no titanium remained in the metal of the heat.

Both series plainly showed improvement in the metal as indicated by the transverse test. Unquestionably the undue cooling of the metal by the alloy additions in the ladle militated against soundness on the part of the bars, particularly for the tensile test—the bars being round—and hence the results obtained should not be taken too seriously. In the case of the transverse bars, however, they are somewhat different, for in the actual test the strain is principally on the outer fibre of a flat bar and this portion of the bar is usually pretty sound. The excellent bending results obtained in spite of the interior shrinkage due to cold metal in the first series of bars gave a more reliable clue to what is going on.

The one interesting point lies in the action on the heavier section where graphite was thrown out. Undoubtedly the cooling action had much to do with this.

Titanium, however, as well as aluminium, when used in comparatively large quantities for purifying purposes has the effect of allowing graphite to separate out easier and doubtless (for the titanium as well as aluminium disappears completely in the dioxidation), here again we see the difference between charcoal and coke for malleable practice. The silicon in charcoal iron charges for malleable ought to be lower than for coke irons, otherwise for the same section the metal would come out "lower." It would seem that the use of titanium in malleable would be particularly advantageous for the heavier classes of work in allowing the silicon to run much lower, and in doing this safely give good, soft, strong castings.

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* Abstract of a paper read before the American Foundrymen's Convention, at Pittsburg.

# The Making of a Pattern.

By W. P.

One of the many difficulties which confront the foreman pattern-maker in the course of his work is to decide on the manner of making certain patterns so that all who have to do with them shall be satisfied. First there is the superintendent representing the employers, who naturally expects to have the work done as cheaply and also as quickly as possible; then there is the draughtsman, who requires that all his little fads (some of which cost money) shall be produced in all their entirety; next comes the moulder, who likes to see a perfect job made, regardless as to whether there is only one or one hundred castings to be made from the pattern, and to be so made that he has only to wave his magic wand (which is very often a 10-lb. hammer) over it, and it will immediately leave the sand in a condition that neither finishing nor making up is required. Then last, but not least, is the man who is to make the pattern, who has his own ideas as to how it should be made, and who, if these ideas should be antagonistic to the "boss," has a tendency to sulk if he does not get his own way.

An example is shown in Fig 1, which depicts a casting for a drum or pulley. As the thickness of metal in such castings is generally about half an inch, more or less, according to the size and strength required, it is not usual to make a wood pattern as shown, without any core print to strengthen the job. The question then is: Which is the best way to do it? It is presumed that the quantity of castings required does not warrant the making of a metal pattern, so it is decided to make it as shown in Fig. 2. It is here seen that the outside has been built up forming a core print and with the inside turned out to the shape required. This can then be moulded in an ordinary two-part box, with the joint as shown at A A. The moulder's objection to this manner of making the pattern was the necessity for using gaggers, or having a special cope made, in order to lift the inside away, saying that it would be much better for him to have it made with the insides cored out, and the outside made the form required. The altered pattern is shown in Fig. 3. This meant having a three-part box with the joints at B B and C C, the pattern being jointed at A A.

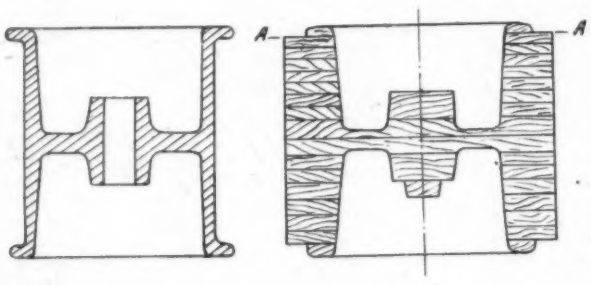



FIG. 1. FIG. 2.

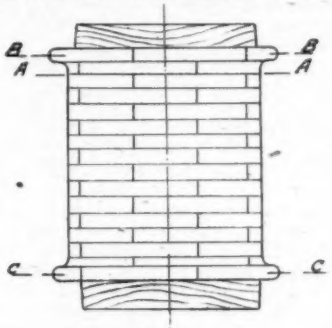



FIG. 3.

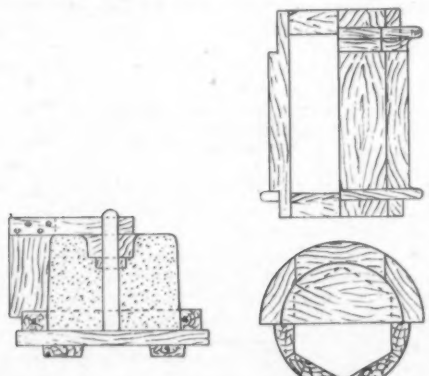


FIG. 4. FIG. 5.

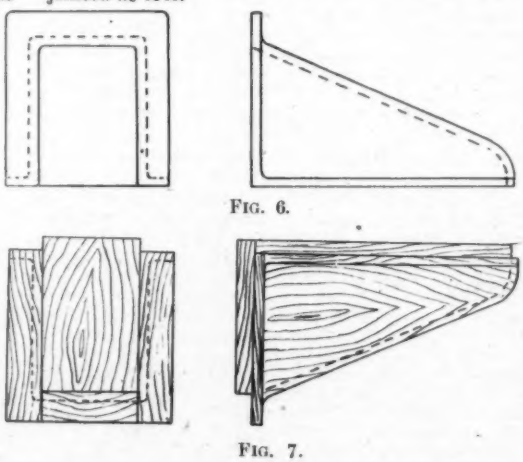


FIG. 6.

FIG. 7.

It is obvious that both ways of moulding have their respective advantages, and it is simply a question of the moulder's way of looking at them, and to some extent, the convenience he already has at hand for dealing with the work. If only one or two castings are required, the core for the inside of Fig. 3. could be made on the pin board, as shown in Fig. 4. Of course, if a number of these castings are required, an ordinary core-box would be made. Figs. 2 and 3 show

the pattern made by building up with segments; this is the best way if the casting is only a short one.

Another way of moulding and also making the pattern is shown in Fig. 5, and this is a better way of making the longer drums than those shown in Figs. 2 and 3. It will be seen that this is built up with staves, one of the flanges being fixed on the pattern and the other one made in six pieces for the convenience of moulding, as it is required to be withdrawn from the sand after the pattern is lifted away. In this case an ordinary two-part box is sufficient for the moulding.

Another job about which a difference of opinion might exist is shown at Fig. 6, which is an end casting for a line of water-troughs. The pattern was made in the boxed-up form with the prints attached, and the inside to be cored out, as shown in Fig. 7. In this instance the moulder objected to the cost of making separate cores, besides having to se-

FIG. 8.

cure them in the cope and then lower into the mould. It is not absolutely necessary to fix the core in the cope, because it can be placed in position in the drag, one end resting on the print and the other end resting on and supported by studs, a liberal allowance of taper being put on the prints. However, he was not satisfied until he got the pattern altered so that it would leave its own core, which practically meant making the pattern over again to the form shown in Fig. 6.

Yet another example of uncertainty is shown in the gear housing, Fig. 8. After the previous experience, one might think it would be safe enough to make this pattern also to leave its own core, therefore a good metal pattern was made and everything thought to be "O.K.," but we had reckoned without our host in the form of the foreman over the malleable iron department. Nothing would please him but having the pattern made with a print on the bottom and a core-box to suit. Fortunately there was not much labour involved in the alteration, as the shell was used by

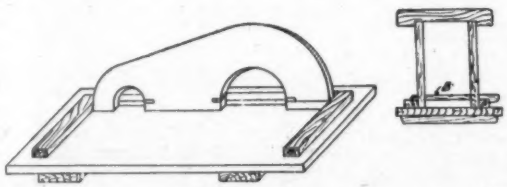


FIG. 9.

fitting wood blocks inside the pattern and fastening the print to them. The core-box was made as shown in Fig. 9, one side of the box being shown removed. This requires few comments. The wood stay at the top is to keep the sides in position whilst being rammed up. Preparation is made near the bottom of the box for inserting tie strips B, which are required to keep the sides of the casting a uniform distance apart. Strips were also cast across the space marked A, Fig. 8, for the same purpose, but as these holes had to be machined this latter strip was done away with; it was found to be better practice to make the castings without these holes in the sides and have them cut out afterwards.

It is possible to make this mould in a two-part box, but the thickness of metal for these housings is only 3-16th inch; therefore it is obvious that if a two-part box were used there would be a serious risk of crushing either the core or the mould, owing to the difficulty in guiding the cope over the core, which has to be fixed in the drag. To get over this, a special three-part box was made. This is shown in Fig. 10. The core was first fixed in the drag, and the middle part could then be lowered over the top of this without any risk, as the core could be seen all the time from the top, or, if thought necessary, guiding strips could be used. The cope could then be put on, the pins in the box being long enough to act as guides.

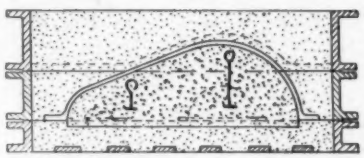


FIG. 10.

Perhaps the examples given in the above will suffice to show that it is not always safe for the pattern-maker to jump to conclusions regarding the best way to make certain patterns, and that where any doubt exists it is advisable to have a word with the moulder when possible, always, of course, bearing in mind that other departments have claims which must be considered, and these the pattern-maker must be able to defend.

## Castings in Permanent Moulds.

In the course of a Paper before the American Foundrymen's Association Convention, during May last, Mr. E. A. Custers explained that the permanent mould is not a cure-all for all foundry ills. Manganese and sulphur should be avoided in the mixture, since high manganese makes the castings hard and brittle, and sulphur has the same effect. Between 2 and 3 per cent. the amount of silicon has no effect on the hardness of the iron, since it is not given time to cause the precipitation of graphitic carbon. An ideal iron for permanent moulds would analyse as follows—

| | Per cent. |
|---|---|
| Silicon | 2.25 |
| Sulphur | 0.04 or less |
| Manganese | 0.04 or less |
| Total carbon | 4.00 |

In the course of the discussion on this Paper it was stated that thin or thick castings are taken out of the mould in practically the same time, but in the case of thick castings only the outer shell has hardened. When permanent mould castings are plunged into cold water at a yellow heat, the combined carbon is raised and the grain made finer, but the iron is not whitened. Plunging in oil merely closes the grain. High sulphur or manganese generally makes it hard to prevent blow-holes, and shot are produced in the castings by the splashing due to careless pouring.

We have received from the Kitson-Empire Lighting Company, Limited, of Wharf Road, Stamford, a set of lists of their "Kitson-Empire" lights, for factory and works lighting by petroleum and petrol.

# The Education and Training of an Engineer.

On June 28th and 29th last an important conference to discuss questions connected with the education and training of engineers took place in the hall of the Institution of Civil Engineers, under the presidency of Mr. Alexander Siemens. The different phases of the subject were introduced by short contributions by eminent educational authorities, which were afterwards discussed. The subjects were classified under the headings: (1) General Education; (2) Scientific Training; and (3) Practical Training. Speaking on the first subject, PROF. SILVANUS P. THOMPSON, D.Sc., F.R.S., contrasted the present unorganised state of secondary education in this country with that which exists in the secondary schools all over Central Europe. Austria, Prussia, Bavaria, Switzerland, and even Denmark, are vastly ahead of us here. In all German secondary schools, whether of the Gymnasium, the Real-Gymnasium, or the Oberrealschule type, there is a perfectly definite goal before every boy in the school. Before he reaches the Ober-prima, or topmost class, he will have to pass the "Einjährige" examination, or pass out disgraced; and it is his ambition and that of his master that he shall pass not only this, but also the Abiturient or Maturity examination some three years later. If he passes the Abiturient examination of his school—an examination held in his school by co-operation of his teachers with the Government Commissioner who comes to conduct it—the way is open for him to any University and to any professional career, except a military career, which begins earlier in the cadet schools. If the German boy fails to pass the Maturity examination of his school he is marked as unfit for professional life. The immense advantages of this reasoned organisation of the secondary schools can hardly be over-stated. A good systematic secondary education is guaranteed to the majority of the boys. A master who might neglect the interests of the majority to specialise on a few clever boys is at once discredited. The test is really a test of the quality of the school. It does not depend on the fashion or the prejudice of a University Board. The State, co-operating with the school, sets the standard and decides whether the school is efficient or not. Throughout Prussia, Bavaria, Austria, and Switzerland, the Universities have long ago abandoned reliance on their individual matriculations, and accept the certificate of Abiturient; they preserve, it is true, a matriculation test, but only for exceptional cases. Here, with us, the State has not yet (save in Scotland) organised the secondary schools. Each University wastes its energies over holding matriculations and the like.

PROF. ALFRED SCHWARTZ, M.Sc.Tech., contended that the function of the secondary school is to give a liberal general education, that is, to impart a limited amount of knowledge, in a range of subjects so selected and dealt with as to develop the mental faculties in a comprehensive manner. The function of the college course is to impart a certain amount of knowledge of a specialised character, and to train and develop further the mental faculties along specific lines. The function of the entrance examination for university or college courses in engineering science may be taken to be the determination of the fitness or otherwise of the candidates to pursue the contemplated course of specialised study. He considered that in the case of the engineer, his secondary school training should be on as liberal lines as possible, since his subsequent training in the college, the workshop, and the office is largely materialistic. What is wanted in the engineering courses is a supply of students with a wide mental outlook, whose faculties have been well trained and evenly developed, and any specialisation in the secondary school at the expense of this liberal training is to be deprecated.

### Scientific Training.

Writing on the position and uses of engineering laboratories in relation to education at college, Prof. Bertram Hopkinson, M.A., B.Sc., F.R.S., contended that experiments in an engineering laboratory may be of great assistance, but in interpreting their results it must never be forgotten that the artificial control of conditions, which is of the essence of experiment, is of itself a disturbing factor. Experiment plays a part which though still subsidiary, is relatively more important. The position of the engineering laboratory as an instrument of education is not quite the same thing as its position in relation to research, but is closely related to it. By no possibility can the conditions of practical work be completely reproduced in the engineering laboratory. In the first place industrial apparatus, even of a simple character, is too complicated to be used as a means for demonstrating elementary physical laws to students who are quite ignorant of their working. Hence work in the engineering laboratory proper should be preceded by a short course of ordinary physical experiment under the simplest possible conditions. But, though small, the machines in the engineering laboratory should be real commercial machines, such as are bought and sold in the ordinary course of business, and the students should use them under ordinary working conditions.

On the same subject, Prof. William Ernest Dalby, M.A., B.Sc., remarked: In a lecture-room a student hears things, but in a laboratory he does things; and a normal student remembers what he does and forgets the greater part of what he hears. A youth anxious to become an engineer is generally born with a desire to do things; and thus the material which we have to train in our engineering colleges is peculiarly susceptible to laboratory teaching. Through the work he does in the laboratory comes the desire to hear rightly in the lecture-room.

### Practical Training.

The relation of practical training to college study was dealt with by Prof. Archibald Barr, D.Sc., who said: "The alternatives before the colleges are: (*a*) The offering to the student, in the limited time at his disposal, of a general course of study that may form a basis for practice in any department of our wide profession; or (*b*) the provision of a number of courses, from among which the student may select the one that appears to bear most directly on the particular branch he expects to follow. Little specialisation should be attempted, if for no other reason than that the young engineer, if he has the elements of success in him, cannot foresee the trend his career will take. The best college course is the one that is most educational, and this will be the course that gives the student the broadest outlook upon his profession. It need deal little with the details of specialised practice; these can best be learned in the workshop, the field or the drawing office. Men who are successful in engineering practice seldom follow in later life the particular branch of work in which they have been trained. Moreover, the conditions of practice, even in one limited sphere, are constantly changing. The question as to the order in which the two sections of the engineer's training should be pursued is also one that admits of no general answer. What will be best for one man may not suit another. There is

something to be said for, and something against, each of the alternatives. But one branch of the pupil's training need not be postponed until the other has been completed—they may be taken on the "sandwich system."

Prof. Henry Louis, M.A., D.Sc., in a note on the same subject, said: "Directly on leaving school, I would have the engineering student pass his matriculation examination, and then go to a suitable works (using this word in its widest sense) for three to six months, then come to college for his three years' course, returning to the same, or to a different works, for some three months during each long vacation, and then finally serve a two or three years' apprenticeship. I think that any manual work is best done in the time between school and college. Many teachers will probably support my view that an engineering degree course should extend over four years instead of three as at present—a view to which I find that general opinion is now gradually trending. Every branch of engineering has to-day assumed a high degree of complexity, and I do not think that seven years is too long a period to devote to the acquisition of the necessary technical knowledge."

### Some Important Suggestions.

The relation of engineering employers and colleges from the point of view of the practical training of college students was discussed in a note by Mr. J. W. Horne, who put forward some important suggestions, which we cannot do better than quote: "The consensus of opinion among engineers of experience and standing of the present day appears to be that the youth who wishes to become an up-to-date engineer and have a successful career in the profession, having reached matriculation standard at school, should preserve the continuity of theoretical study and proceed at once to university or college for two or more years. . . . Many engineering employers, during the last few years, have recognised that systematic scientific education of the modern university and college type is very essential to the future progress of engineering science, and in consequence have extended sympathetic assistance to college students by granting them facilities to obtain practical experience in their workshops, in order that they might have the opportunity to build up that 'engineering instinct' which is so necessary to become a successful engineer. The authorities of the universities and colleges, also recognising the necessity for this workshop period after the completion of the college course, endeavoured, and with very considerable success, to arrange with a number of engineering firms in the industrial centres in which they are situated, to co-operate with them in granting college students the privilege of this workshop training. But what strikes one, after a careful study of the apprenticeship schemes as arranged by the college authorities, is that the co-operation between college and employer is not sufficiently definite, as will be seen from the following, taken from the scheme of one of our best organised colleges:—'Students who desire to serve their apprenticeship with one of the after-mentioned firms must communicate direct with the firm and make their own arrangements."

"By this system it is possible, and, as a matter of fact, in the writer's experience in many instances it has happened, that suitable students, possessing the necessary personality and 'engineering instinct,' will lose much time, after leaving college, through being unable to make arrangements to proceed to their practical training at once, and that others will have promising engineering careers blighted by being unable, through lack of influence and means, to arrange for their practical training. It is an undoubted fact that only a certain proportion of engineering students who finish their college course successfully are suitable to proceed to the workshop for practical training, and the purpose of this note is to suggest an arrangement to ensure that engineering employers shall be asked to give facilities for the practical training of only the most suitable students. The professors of engineering subjects in the universities and colleges, are, as a rule, qualified engineers, who have had considerable experience of works' practice, and, in consequence, they are in a unique position, after three years' close contact with the students, to select the most suitable, from the point of view of ability, personality and grit, to take full advantage of their years of workshop practice, and this method of selection would ensure that want of influence, poverty, or social circumstances, would be no bar to a suitable student completing his engineering training. The selection could be made before the completion of their course and arrangements made so that no time should be lost.

"In the provincial industrial centres it would seem to be a not very difficult problem to arrange for a close and definite co-operation between the engineering employers and the heads of the engineering departments of the colleges on the above lines, in view of the fact that the 'civic' Universities, such as Manchester, Birmingham, etc., and the Technical Colleges, such as Glasgow, have been built and highly equipped by contributions from the local captains of industry, who in this way have shown a living interest in the advancement of scientific training. The governors of these provincial colleges, in order to have the education thoroughly in keeping with the advance in industrial methods, have adopted a liberal policy in their methods of management, and in order always to be in close contact with the various industries in their district, they have adopted the wise policy of co-opting leading representatives of the various firms to act on the committees of each department. It would appear, therefore, to be a simple matter for each centre to form a strong committee, in connection with the college, composed of these influential representatives and the heads of the engineering departments. The duties of this committee would be:—(1) To consider the selection of students made by the professors. (2) To make arrangements with the firms who are willing to grant facilities for practical training to start these immediately on the conclusion of the college course. (3) To arrange that Recommendation 9 of the Report of this Institution be carried out as far as possible. (4) To induce a still greater number of firms to grant such facilities.

"The question of an arrangement on the same lines between the colleges and polytechnics in London and engineering employers is much more complicated and more difficult to solve. In London a number of unconnected colleges and polytechnics came into existence during the latter part of the nineteenth century, due in a great measure to the subsidising of engineering training by the wealthy and generous city companies, with the result that there is not as yet any central governing body who could act in unison with the various colleges and with engineering emp'oyers in London and the provinces to arrange for the practical training of all the most suitable students educated in the London colleges. In consequence of this condition of affairs, each college has had to make its own arrangements, with the result that many capable students have been unable to arrange for their practical training. The Imperial College of Science and Technology has now been in existence for some years, and has nearly completed its equipment in all departments of science, an equipment which I believe is second to none, and will soon be in a position to produce students of the very highest standard of college training, for whom the very best facilities for workshop training must be found.

Why should united action not be possible between the Imperial College of Science and the Polytechnics? Why should not a central committee be formed with its headquarters at the College of Science, composed of the heads of engineering departments of these unconnected colleges, and representatives from the London managers of engineering employers and manufacturers, to work on lines already suggested in the case of the provinces? This committee would be in a position to ensure that all the most suitable students in London would obtain their practical experience.

"There is still another important problem which is worthy of mention in this note, a problem which has arisen in England during the last few years owing to the advance made in general education, and which is now pressing for solution. During the last few years, engineering firms in this country have developed a very keen interest in the better education of the engineer's apprentice who starts his apprenticeship at 16 years of age. Every encouragement is given to him to attend evening continuation classes, and several firms allow the best of them to attend classes one or two afternoons a week. The result of this interest is that a certain proportion of these have, by means of such facilities, been able to reach a standard of education which qualifies them to proceed to a fully-equipped college for two or three years of specialised study in the day-time. Want of means and lack of an adequate system of scholarships with maintenance allowances, however, prevent them from proceeding further in their ambition. These apprentices, trained in this manner, are a very valuable asset to the nation, and I would suggest to the education authorities that they should adopt a scheme whereby the best of them would derive the benefit of systematic scientific education in the day-time at one of the fully-equipped colleges. The organisation of such a scheme must ensure that poverty or social circumstances shall not prevent access to the highest forms of training that the community can provide."

### Division of Practical Training.

In a note on practical training in workshops or on works of construction, Sir H. F. Donaldson, C.B., stated that whatever the sequence of the acquisition of knowledge, he was strongly of opinion that six years represented the absolute minimum period necessary to adequately equip a young engineer, in some, if not most, classes of engineering. Assuming that the theoretical work should be taken first, or after a year in the workshops, and that it will last three years, there remains the apportionment of the three or four remaining years out of the six or seven years to be considered. Workshop practice is essential for all branches of engineering, and he sets the minimum for this course at three years, either all after theoretical knowledge has been acquired, or one year before and two years after that period. For a mechanical engineer he suggests the following apportionment of time :—

| | Months. |
|---|---|
| Machining ... ... ... ... ... ... ... ... | 9 |
| Fitting ... ... ... ... ... ... ... ... | 9 |
| Boiler-shop, erecting, millwrights, electrical appliances for workshops ... ... ... ... ... | 9 |
| Patternmaking ... ... ... ... ... ... ... | 3 |
| Foundry ... ... ... ... ... ... ... ... | 3 |
| Smithy ... ... ... ... ... ... ... ... | 3 |

This occupies the full three years, and is none too long, but it allows no time for office work, either drawing office or otherwise, and leaves that part of the education to be taken as an extension to the workshop course. In order partially to meet the requirements of the bye-laws of the Institution of Civil Engineers, the author has arranged the distribution of three years for the young men joining the establishment which he directs, as follows :—

| | Months. |
|---|---|
| Machining ... ... ... ... ... ... ... ... | 8 |
| Fitting ... ... ... ... ... ... ... ... | 7 |
| Erecting, millwrights, electrical appliances ... | 8 |
| Patternmaking ... ... ... ... ... ... ... | — |
| Foundry ... ... ... ... ... ... ... ... | 4 |
| Smithy ... ... ... ... ... ... ... ... | 3 |
| Drawing-office ... ... ... ... ... ... ... | 3 |

The sequence in which the various shops are taken should, of course, be arranged to suit not only the young man himself, but the nature of the work which is done at particular times in particular shops, and it is to be noted that in the second distribution mentioned, the time in the foundry has been increased by one month, based upon the author's experience of young men serving with him.

## Oil as an Air-Furnace Fuel.

Speaking before the American Foundrymen, Mr. W. N. Best pointed out that, according to analysis, oil has a much higher calorific value than coal, and therefore should be able to melt metal in a much shorter period of time than coal. Further, when oil is used as fuel, the castings contain no more sulphur than the metal did when charged into the furnace, and the tensile strength is consequently greater than of metal melted by coal fire. As the melter has the furnace under perfect control, the heats can be taken off much quicker than while burning coal, and the temperature of the charge while being tapped can be maintained without varying more than 25 deg. Fah. until all the charge has been run from the furnace.

According to the author, the change from coal to oil is a very simple matter. In the original firebox he constructs a combustion chamber of such form and proportions that the air necessary for perfect combustion can unite with the atomised fuel before it reaches the furnace, which prevents oxidation of the charge. Also this chamber causes the heat to be deflected upon the entire surface of the bath. In the end of this combustion chamber is placed a hydrocarbon burner of special form, which makes a fan-shaped blaze, filling the entire chamber with flame. This burner exteriorly atomises any liquid fuel which will flow through a ½-in. pipe, such as fuel oil, crude oil and tar. Its construction is such that it cannot carbonise, and there are no parts to wear away or get out of order. A very small quantity of compressed air is used through the burner to atomise the fuel and distribute the heat, while the balance of the air necessary for perfect combustion is supplied at from 3 to 6 ozs. pressure through a volume air nozzle.

The furnace is charged in the usual manner. The burner is started by opening the air valve, holding by means of tongs a piece of burning waste well saturated with kerosene under the burner, and then turning on the oil. The reduction in the time required to get the charge ready for tapping is not the only point wherein oil is more economical than coal. There is no handling of fuel and ashes, and there is a great saving in floor space, for the oil tank is placed underground. The firebrick lining of the furnace lasts 20 per cent longer than with coal. Poor castings or imperfect ones caused by the metal being cool or sluggish are obviated entirely.

THE firm of Martyn Brothers, engineers and ironfounders, Airdrie, has been dissolved as at July 13, by the retirement of Mr. William Martyn. The business will be carried on by Mr. P. B. Martyn, the remaining partner, under the name of Martyn Brothers.

# Annealing and Manufacture of Converter Steel Castings.*

By Bradley Stoughton.

Annealing steel castings is not always a necessary operation in their manufacture, and especially in the case of small castings which have not great length to produce severe strains by shrinkage. While it cannot be denied that proper annealing must benefit all steel castings in greater or less degree, on the other hand, annealing as too frequently practised, is often more of a detriment to some castings in the heat than it is a benefit to the remainder. Annealing has the two-fold purpose of relieving any strains produced in the metal during cooling in the mould, and of improving the strength and ductility of the metal by breaking up the coarse structure inevitably developed to some extent during cooling from solidification, and, in some cases, amounting to that extreme degree of coarse crystallisation which causes the appearance known as "ingotism."

FIG. 1.—STEEL OF 0.50 % CARBON; GRAIN OF ROLLED STEEL. MAG. 40 DIAM.

FIG. 2.—SAME STEEL AS FIG. 1. COARSE GRAIN DUE TO HEATING TO HIGH TEMPERATURE. MAG. 40 DIAM.

FIG. 3.—SAME STEEL AS FIG. 1. RE-HEATED TO "REFINE" GRAIN. NOTE SKELETON STRUCTURE SHOWING OUTLINES OF FORMER LARGE CRYSTALS. MAG. 40 DIAM.

Annealing to relieve strains is a comparatively simple operation, but annealing to produce the best grain obtainable, which shall in turn give the highest possible combination of strength and ductility to the casting, is an operation often imperfectly understood and crudely practised in foundries.

The microscope and some form of pyrometer, however crude, is an invaluable adjunct to annealing practice. The time has passed when steel foundries could obtain the best results in competition by means of the unaided eye. The pyrometer will indicate when the steel has reached that temperature which will give to it the best grain, and therefore the best physical properties, while the microscope will tell whether or not this heat treatment has performed its work as thoroughly as it should.

### Structure of the Metal.

If the structure of the casting after its first solidification is not excessively coarse, heating it slightly above its critical temperature, maintaining it there until the heat has penetrated to the most remote point, and then for about one-half hour thereafter, will produce the desired result.

But if the steel has been cast at an excessively high temperature, or if it cooled with unusual slowness through the first 200 or 300 degrees after solidification, or if, in any other way, an unusually coarse and open crystalline structure has been produced, the process of annealing described above, even if protracted beyond the time limits mentioned there, will not completely obliterate the coarse crystals. The large crystals will be broken up into smaller ones, it is true; nevertheless, a sort of skeleton work, showing indistinctly the boundaries of the previous large size crystals, will persist, and the steel will be somewhat below normal in strength and ductility, or both. This point is better understood by reference to Figs. 1, 2, and 3. Fig. 1 shows fine-grained steel as produced by forging or rolling; Fig. 2 shows the same steel in a very coarse crystalline state; while Fig. 3 shows the same steel after again reheating above its critical temperature. It will be seen that the large crystals are broken up into smaller ones, but there still persists a skeleton work showing the outline of some of the coarse grains. Figs. 4, 5, and 6, on the other hand, how steel in a finely-grained condition; the same steel with a coarse structure, and finally this coarse structure refined almost to its original condition.

In order that the steel shown in Fig. 3 might be refined as completely as that shown in Fig. 6, two steps in the annealing would be necessary. The coarse-grained steel would first have to be heated for an hour or more after a complete soaking at a temperature far above its critical temperature. This would produce a structure intermediate between that of Fig. 1 and Fig. 2, and would obliterate the skeleton work showing the outlines of the previous coarse crystals. Such a casting must then be cooled to a black heat, and subsequently reheated slightly above its critical temperature in order to give it the best possible physical qualities. This double process, of

*Abstract of Paper read before the American Foundrymen's Convention, at Pittsburg.

course, involves a waste of time, heat and labour, and the bad quality of the coarse-structured steel may not always be bad enough to justify this expenditure, but it should be remembered that this double process and this alone can redeem steel castings of extraordinary coarse crystalline structure.

### Cooling through the Critical Range.

Another point about the annealing of steel castings, which is not often emphasised, is that slow cooling through that limited interval of temperature known as the "critical range" is detrimental to both strength and ductility. Slow cooling below 1,200 degrees F. will improve the ductility of the metal, but slow cooling from 1,700 down to 1,200 degrees F. develops thicker grains of ferrite and cementite and reduces both strength and ductility.

Fig. 7 shows the critical range of steel and iron. Most of our steel castings contain less than 0.50 per cent. carbon, and therefore, the critical temperatures above which they are to be heated are located in the line G O. To cool the steel slowly from above the line G O to below the line P S K will develop thick crystals of ferrite and cementite.

Because of this circumstance there has arisen a process of annealing which consists in maintaining the steel castings above their critical temperature

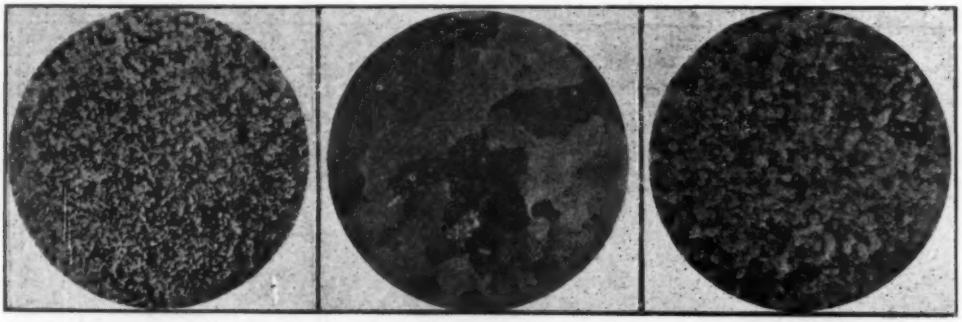


FIG. 4.—STEEL OF 0.05 % CARBON; GRAIN OF ROLLED STEEL. MAG. 40 DIAM.

FIG. 5.—SAME STEEL AS FIG. 4. COARSE GRAIN DUE TO HEATING TO HIGH TEMPERATURE. MAG. 40 DIAM.

FIG. 6.—SAME STEEL AS FIG. 4. RE-HEATED TO "REFINE" THE GRAIN. MAG. 40 DIAM.

about half-an-hour after they are completely soaked, then pulling them out so the air will blow upon them until they are at black heat; after which they may or may not be returned to the furnace and allowed to cool as slowly as they will. Of course, it must be remembered that this method of annealing may set up strains in castings of very complicated shape, and the castings must also be so piled that they will not strain each other during the expansions and contractions which they undergo while cooling through the critical interval.

### Seger Cones and the Magnet.

It may be of interest to the foundrymen here present to know that Seger, which cones may be purchased from the chemical supply houses and elsewhere, serve a valuable purpose in annealing work. These Seger cones are little forms of clay, melting at a great variety of temperatures. If these cones be placed in a furnace along with the castings, their melting will show when any particular temperature is attained. It is also possible to put cones in different parts of the furnace to determine the uniformity of the heat.

An ordinary horseshoe magnet is a valuable adjunct in annealing castings, because castings of 0.50 per cent. carbon and less lose the power of attracting a magnet when they reach a temperature of 1,550 degrees F., which fact may be used as a check in estimating the temperature of the annealing furnace, and this is especially valuable because this particular temperature (*i.e.* 1,550 degrees F.), is only a short distance below the correct one for annealing.

### Small Steel Castings and the Converter Process.

The manufacture of small steel castings by the converter process has been already discussed so thoroughly that not many points remain to be covered. One matter, however, which has not been sufficiently exploited is that of silicon in the pig-iron, which varies from 1.50 per cent. going into the cupola (equivalent to, say, 1.25 per cent. in the melted pig), up to sometimes as much as 2.50 per cent. No doubt a greater proportion of silicon is required when only a few heats per day are made, as well as when the blowing is slow and when the metal is retained a long time in the converter; as, for example, if it is poured out into hand ladles, requiring 30 minutes or so per heat. In the writer's opinion hotter steel and less loss may be obtained by rapid working and lower silicon—say, not more than 1.75 to 1.50 per cent., into the cupola.

Silicon has a treble effect in causing waste of metal:—

(1). It is the slag producer of the process. Every unit of silicon present is oxidized, enters the slag and remains there permanently. In this respect silicon differs from iron, manganese and other elements that are oxidized, all of which may be afterwards partly reduced by the carbon and given back to the metal. Side blow converter slags are composed chiefly of silica and oxide of iron (with a certain amount of manganese, depending upon the manganese in the pig-iron used). It will have been noticed by all those accustomed to have these slags analysed, that every type of practice automatically produces a slag of a certain analysis in iron. Colder blows may increase the amount of iron in the slag, and vice versa, but, as a general thing, the iron content of the slag is approximately uniform, and therefore the weight of slag will determine the weight of iron lost in it. For example, if a slag normally contains 30 per cent. of iron and weighs 10 per cent. of the bath, then the amount of iron lost in the slag will be 30 per cent. multiplied by 10 per cent., equals 3 per cent. of the total metal present, If, on the other hand, a slag weighs 15 per cent. of the bath, and contains 30 per cent. iron, then the corresponding metal loss will be 30 per cent., multiplied by 15 per cent., equals 4½ per cent. The amount of slag produced is an important cause of waste of iron.

(2.) A second source of loss due to silicon is increasing the length of the blow, and especially the interval before the carbon begins to burn. During this interval there is a large amount of brown smoke formed in the converter, all of which represents loss of iron by oxidation and volatilisation. The longer this action continues the greater will naturally be the iron wasted by this means.

(3.) Finally, all the silicon introduced with the pig-iron is burned up, and this likewise represents a loss of weight.

The writer is also in favour of rapid working as a cause of hotter steel, lower cost for labour, less loss in skulls, etc. It would seem that every plant should aim to produce at least three blows per hour, and at the rate of not less than twelve blows between 1 p.m. and 4.45 p.m.

### Converter versus Open-hearth Furnace.

A good deal has been said and written about the many failures of converter steel foundries in this country, which have been all too frequent. The converter process has naturally had to bear the blame for these failures, but the causes lie deeper than the process itself. A converter foundry is almost fore-

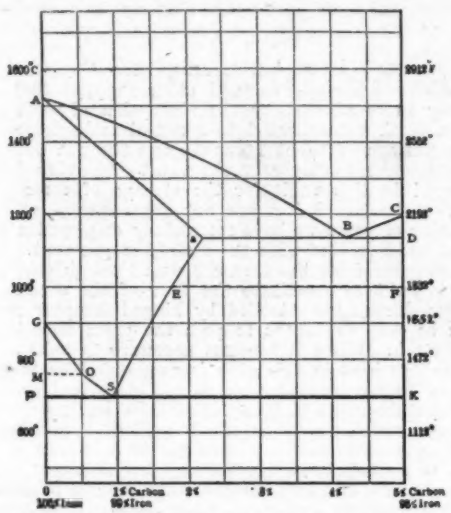



FIG. 7.—CRITICAL RANGE OF IRON AND STEEL.

doomed to failure if it attempts to compete in the open market with the open-hearth process in castings averaging over 100 pounds apiece.

The converter cannot hope to make large castings at as low a price as the open-hearth furnace. It can make small castings at a cheaper price, and can get a better price for them on account of greater freedom from blow-holes, and better appearance and detail. This high price is necessary for the success of a converter foundry, however, because an open-hearth foundry will usually underbid the price on small castings for one or both of two reasons :—(1.) An open-hearth foundry with large production can afford to lose money on a comparatively small amount of castings for the sake of other business. (2.) Open-hearth foundries frequently do not know how much their small castings cost them, because they do not segregate the small castings from the large and estimate separately the percentage of defective castings, which is what runs the price up to such a high figure in openhearth practice. In making a comparatively small tonnage of small sized castings, the percentage of defective castings in this class may be as high as 20 per cent. without this fact becoming evident on the daily or monthly statement, except occasionally by accident.

Another frequent cause of failure of converter foundries is lack of sufficient capital with which to do business on a business basis. The cost of installation of a converter foundry is so small that many companies rush in with small capital. This has happened so frequently that buyers of steel castings are always ready and prepared to take advantage of the opportunity, and they soon learn when a foundry is in difficulties and is ready to accept work at low prices for the sake of quick cash. More often than not the final result is failure and abandonment after a few months' struggle, but unfortunately there are usually enough of these tottering companies in the field to keep the market for small castings in a disorganised condition, to the serious detriment of the business. This is not real competition, and in the end will drain the strength of the industry as a whole.

It would seem that both open-hearth and converter foundries could serve their own interest best by agreeing to divide the field on a logical basis, each process confining itself to the class of castings which it can make to the best advantage. It seems to be now pretty generally admitted that the converter can make small castings of higher quality as regards freedom from blow-holes than the open-hearth furnace, either acid or basic.

The writer thinks, also, that if open-hearth foundries will take the trouble to figure their defective castings in small sizes separately and apart from their general run of castings, they will find the percentage so high that the cost of making them will be seen to be greater than if they put up a converter for the purpose, or else sublet the work to a converter foundry. On the other hand, a converter foundry cannot make large size castings so as to compete on a fair basis with the open-hearth process.

## Time-Saving by Moulders.

An interesting example of how economy in time and trouble may be effected in the foundry was given by Mr. B. D. Fuller before the American Foundrymen's Association. "Suppose," he says, "we wish to make a casting the shape of an oil or molasses barrel, to be cast on end. The usual procedure would be to make the pattern in two parts divided in the centre at the greater circumference, thus necessitating a deep cope, or should the pattern be large, 8 to 12 ft. in diameter for instance, we would bed in the floor, make a slanting parting down to the centre, or dividing line, and use lifting plates; part again at the topmost line, lift the plates from the centre with the cope, draw both parts of the pattern, replace the cope, release the bolts to the lifting plates, lift the cope, and finish the mould."

"Good results can be obtained by this method; but suppose we make the centre or core of the pattern to resembled a section of water pipe, build on the outside in staves, fastening the staves by eye bolts through the centre pipe, cover the upper end of the pipe with a lid, ram up simply a two-part mould, lift the cope, remove the lid of the pattern, go down inside and unscrew the eye bolts, draw out the centre and pick in the staves; the result is a perfect mould, made in much less time, doing away with centre parting and much lifting, etc. How much this would mean in a shop where patterns of this style are numerous?"

# Non-Ferrous Foundry Economies and Refinements.*

By E. A. Barnes.

In order to get the best results out of any foundry it must be the concern of the management not only to take into account the large and apparent items of loss, but to give attention to the minutest details. This is where the intelligent work done by technically-educated engineers and chemists can be of great assistance. Up to a few years ago a brass foundry was either an adjunct of the iron foundry or considered one of the least important departments of any manufacturing industry, and even to-day one can visit large, pretentious plants in which the brass and aluminium foundry is apparently of minor importance. The turning out of the necessary castings from which costly appliances are finally produced does not receive such expert attention as does the factory itself, in which latter labour-saving devices and schemes of all kinds are found to exist.

The modern foundry, in place of being relegated to the basement or some lean-to at the back of the works, should be designed expressly for the purpose, having in mind not only rapid and economical production, but the scientific handling and storing of the raw materials, keeping account of the same until they are used on the floor or melted in the furnaces and finally weighed up and turned out in the form of finished castings.

The building should by all means be fireproof. Many designs lend themselves to non-ferrous metal foundry practice, the saw-tooth having its advocates where land is cheap, and the gallery or many-storied buildings where land is at a premium. The writer's preference is for the gallery construction. The lighter brass work and aluminium work can be carried on in the gallery, where there are ample light and air. The first floor can be used for the heavier work, the scrap melting furnaces, the power plant, office, cleaning departments, store rooms, and other miscellaneous uses not strictly connected with the actual melting and moulding.

The heating of a foundry is one of the important considerations. I personally prefer to use direct radiation, derived either from coils of iron pipe built along the walls under the windows, or sectional cast-iron radiators similarly placed. Placed under the windows the maximum amount of heat is radiated, tempering the air and distributing it evenly over the building. Ventilation is another point that must be taken into consideration. In saw-tooth and gallery-constructed buildings the lanterns in the roof should be arranged with swinging windows, the natural tendency of the heated gases being to rise and pass out of the same. This action can be augmented by the use of fans, which are absolutely necessary in a building of more than one solid storey.

We have found that the best form of pattern storage is secured by the use of heavy wire netting mounted on light angle-iron supports. These racks are fireproof, the sand that sticks to the patterns eventually falls off, sifts through the meshes, and in place of remaining among the patterns, gravitates to the floor where it can be swept away. The racks being open permit of inspection and ready identification, even if the pattern is ranged on one of the upper shelves. The racks are strong and practically indestructible. Some system of numbering and arranging these patterns is, of course, necessary. The match plates can be stored standing on edge in suitable metal racks and receptacles where the chance of injury is remote. The storage of expensive metals and supplies is best done in fireproof vaults, centrally located, not only to the melting floors and office, but to the elevator which serves the upper stories. It may be even advisable to build store rooms on the upper floors, connecting these with the main-floor storage by limited-capacity electric hoists. The sand bins should be so arranged that the sand can be unloaded through adjustable chutes or a conveyor from the wagons economically and rapidly, and be distributed only as occasion requires to the moulding floors and core room.

In our foundry we have arranged the store room for crucibles, firebrick lids, and other supplies that are likely to be affected by the absorption of moisture, in a brick vault heated to a considerable degree by the passage of spent furnace gases through suitable ducts under the floor of the vault. Shelving is arranged in this vault for the storage of cores that have been baked but are not yet required. For a number of years we have successfully employed a core oven built in line with the main flue gas vent. The spent gases from the furnaces pass through cast-iron ducts built to constitute the floor of the core oven. These ducts are controlled by hinged dampers which can be deflected so as to pass the gases directly up the stack. When it becomes necessary to bake large cores, the heat in this oven is augmented by the use of an oil burner connected to the main fuel system.

It is desirable that a foundry be equipped with suitable toilet rooms in which modern conveniences are installed. In our foundry we have individual hygienic wash bowls alotted to each employee, with running hot and cold water. Each man is furnished with a metallic locker in which to store his street clothes. Shower baths, needle baths, and dressing rooms are provided with hot and cold water. With these facilities, the men can make themselves entirely comfortable and presentable before leaving the premises. One of the floor helpers acts as janitor for this department and keeps it in a sanitary condition. It is an undeniable fact that these accommodations are not only used, but are appreciated by the men. To the unprogressive manager these things appear unnecessary refinements, but our experience of several years has proven to us conclusively that for our forethought and outlay we get a better class of men and a higher grade of work with less complaint than was possible before these arrangements were installed.

As the economical operation of the foundry depends in a great measure upon the uninterrupted operation of the power plant, it is advisable to have the plant under the management of the works mechanical department and separated from the foundry influences entirely. If this is not done, the foundry people, who rarely have any interest in or experience with machinery, allow the same to run down.

The desirable equipment of the up-to-date foundry includes band saws, sprue cutters, tumbling barrels, saw filing devices, sand mixers, etc., and these should

* Paper read before the American Brass Foundrymen's Association, at Pittsburg Convention, May, 1911.

be direct connected to individual electric motors. The initial cost may appear a little higher than if installed with a single motor and line shaft, but the disposition and arrangement of the several tools can be much more economically and practically proceeded with if one is not tied up to a shaft-line drive. Any single machine can be run independently of the others very efficiently if the motor has been properly selected with regard to the work to be done. Such other apparatus as monorail carriers, cinder grinders and washers, magnetic separators and schemes for skimming off the ladles before pouring, etc., can be selected to suit the various requirements.

In the matter of furnaces, ladle heaters, scrap-recovering furnaces, etc., these should come directly under the jurisdiction of the foundry itself, but their use should be supervised and directed by the foundry engineer. Enormous savings can be effected by the intelligent handling of the same. With the old system of coke and hard coal pit furnaces, which, of course, are adhered to for many kinds of work, the greatest injury done to the crucibles is from the rough handling with the tongs and the uneven heating and cooling. With the fuel oil system and tilting furnaces, which are becoming more and more popular, combined with the propagation of a suitable reducing flame in a combustion chamber of sufficient volume and absolute control of temperature, this crucible loss is greatly reduced. It nevertheless calls for much thought and resourcefulness on the part of the furnace tender to produce the best results. It is here often hard to get the old-time foundryman to take a real interest in these up-to-date arrangements.

One of the greatest items of loss in a brass and aluminium foundry is the shrinkage. This is occasioned in many ways. Poor system is responsible for all of them. Volatilisation loss in the methods of melting is the most important. Before building our new foundry we investigated the different types of furnaces and ladle heaters on the market, and as a result decided to design our own melting equipment, continuing the use of fuel oil, which we had found very satisfactory for seven or eight years. In our furnace we employ the concentric burner, using compressed air at about 35 lbs. per square inch to atomise the fuel oil, which is supplied at about 25 lbs. pressure at the nozzle. This fuel oil and atomising air are both preheated by proper arrangements before they issue from the burner. The volume air for combustion, which is supplied through a truncated nozzle surrounding the concentric portion, is maintained at about 8 ounces pressure, and by valves and gates both the compressed air and fuel oil and the volume air are controlled, maintaining a reducing flame whether a slow or a fast fire is desired. It is very necessary to have absolute control of your combustion in order to produce the reducing flame, otherwise at these high temperatures the oxygen of the air will combine with the free graphite carbon and other components of the crucible and furnace lining, and very rapidly disintegrate the same through chemical combination, and the metal itself will suffer loss and injury through oxidation.

Our ladle heaters, which are arranged to use the same burner, are made with a telescoping hood that is raised up when the pouring crucible is introduced and then dropped down, enveloping the same. In this way the crucible is evenly heated. We find these ladle heaters very useful for getting out small batches of work, as the heat generated in them can be as high as that produced in the larger furnaces.

On visiting any foundry one is struck with the enormous amount of apparent lost heat and energy that issue from the vents. This heat, in the form of spent gases, can be utilised for many useful purposes if proper arrangements are made in the design of the foundry to conserve them. Core ovens can be heated, as can also wash water for use in the lavatories; these are two of the most important. The preheating of air and oil is another. This, of course, involves piping and arrangements which may to some appear complicated and unnecessary, but they are nevertheless well worth taking into consideration.

Years ago we abondoned the unhandy and inefficient tub, and in its place designed and installed suitable moulding tables about 6 ft. long and 2 ft. wide. One-half of the top of this table is perforated with 2-in. holes drilled close together, allowing the sand which is cut off the flasks to at once fall through to the storage space below. The other half of the table is not perforated, and constitutes a bench on which the patterns and tools can readily be arranged. Underneath this solid part a drawer with a lock on it is supplied for the security of the moulder's tools, swabs, etc. Each bench is equipped with an air-operated rapping hammer, which can either be fastened by brackets to the bench itself or can be instantly removed and secured to match plates, allowing the moulder at the bench to work either on plate work or individual patterns, as the demand for castings dictates. This rapping hammer is operated from a knee-pad actuated valve, affording the moulder free use of both hands and obviating the necessity of calling for rapping assistance from neighbours or helpers.

All up-to-date foundries have moulding machines. Choice and selection of these machines must be governed in a great measure by the nature of the work in hand. It will be found that certain machines lend themselves to interchangeability of patterns, squeezing, deep draws, shallow plate work, etc., better than others. It by no means follows that because a foundry has moulding machines of one make that an entirely different type of moulding machine would not greatly add to its efficiency.

### Utilising Old Metal.

In a manufacturing industry like the one with which I am connected we get skeleton brass from the punch press department, borings and turnings from the machine shop in large quantities each day. The regular practice is to run these through an efficient magnetic separator connected with a blower system which takes out the iron, paper, and light particles, passing the good metal into bins. In place of selling, we save and separate these borings, etc., and use them in our foundry at once. The copper and red brass borings are taken to the melting floor and are used up with gates, sprues, and new metal. Much of this stuff, however, is of a mixed nature and cannot be so handled; it is, therefore, taken to the scrap melting furnace and run into ingots. These ingots are analysed by the chemist, who determines closely their components. These ingots are further alloyed with pure copper and other new metals in varying proportions, and first-class metal for all general purposes produced from them. We also handle in our scrap melting furnace copper wire from burned-out field coils, armature coils, and scrap generally that is known to contain pure copper. The resultant pigs are analysed and used as base copper for more important mixtures. The furnace is cleaned out, skeleton brass, borings, yellow brass, etc., are run off and stored for future use. With our scrap melting furnace we employ an endless chain arrangement for carrying the chills. The contents of these chills are automatically dumped into water, which cools, cleanses, and softens the metal simultaneously. This system involves the continuous melting and pouring principle, which we have found in practice to be preferable to the "hot bath" system,

where the metal is melted and tapped out into crucibles and repoured. This does not, however, indicate that the "hot bath" system is not better adapted to some other foundry requirements.

A few cases of actual runs of scrap and the losses incident to the recovery of the same are as follows:—

*Bare Copper Wire.*

| | |
|---|---|
| Total wire melted ... ... ... ... ... | 9,054 lbs. |
| Total ingot recovered ... ... ... ... | 8,888 ,, |
| Loss or shrinkage ... ... ... ... ... | 166 ,, |
| Loss in per cent. ... ... ... ... ... | 1.83 |

*Fine Wire.*

(Includes burning off of insulation).

| | |
|---|---|
| Total wire melted ... ... ... ... ... | 3,089 lbs. |
| Total ingot recovered ... ... ... ... | 2,773 ,, |
| Loss or shrinkage ... ... ... ... ... | 316 ,, |
| Loss in per cent. ... ... ... ... ... | 10.24 |

*Yellow Brass Punched Scrap.*

| | |
|---|---|
| Total scrap melted ... ... ... ... ... | 3 000 lbs. |
| Total ingot recovered ... ... ... ... | 2,860 ,, |
| Loss or shrinkage ... ... ... ... ... | 140 ,, |
| Loss in per cent. ... ... ... ... ... | 3.5 |

In our aluminium department for years we had been using the open-flame form of reverberatory furnace and were always confronted with a heavy loss, amounting often to 6¾ per cent. Our aluminium work is of a peculiar nature, light, and of an odd pattern. For every pound of casting we produced we had to pour 1 lb. for the runners and 1lb. for the riser or header. We therefore only received 33⅓ per cent. net of the gross metal melted. The loss, therefore, had to be multiplied by three, making 20 per cent. net. We figure gross weight because we charge so much metal to the melting floor, making a bi-monthly inventory of the castings turned over to the factory and the metal in the form of ingots, sprues, and risers remaining over.

We could not see any immediate relief from this loss, so carried on experiments from time to time, and finally decided that a tilting furnace similar to our regular crucible furnaces, but arranged with an iron kettle of the proper dimensions and shape, was the solution. With this new type of furnace we are able to handle the same number of pounds of aluminium per heat as with the old open-flame furnace with a loss of only 2½ per cent. gross, as it eliminates entirely the loss due to the cutting action of the flame. In the iron kettle the flame does not touch the metal at all, and, while the time employed in getting out the first heat is necessarily longer, it does not materially affect the total output. Another great advantage in the kettle type of furnace is that the slag and oxide which form on the top of the pot act as a protection to the metal, and the spatter, skimmings, etc., instead of being thrown into the scrap pile, are returned to the melting pot, where the globules of metal held in suspension in the slag separate from the slag and mix with the metal below, the slag itself remaining on top in the form of a protecting blanket. In the melting of our metals such as aluminium, we employ pyrometers. We have found by using these instruments that the overheating of the metal is avoided.

### Pre-alloying of the Metals.

A great economy results from the pre-alloying of metals. In alloying aluminium and copper it is a well-known fact that the copper, which melts at a much higher temperature than the aluminium, must be melted first. The aluminium is then added, combines with the copper, and through chemical action the temperature is liable to rise to a point that vapourises off much of the aluminium. To rob this phenomenon of its most harmful effects we have made a practice of compounding a rich alloy of half and half copper and aluminium, which we throw into pigs. The copper is melted first and the aluminium is added in small quantities, allowing the temperature to gradually reduce with each addition of aluminium, thus preventing overheating any considerable quantity of metal. This rich alloy, which now necessarily melts at a very much lower temperature than the original copper, is used in the final compounding of our aluminium mixture. All risk of overheating or mis-mixing large and individual batches is thus eliminated. Not only this, but the remelting has a refining effect, and a much better product is ensured.

The use of fluxes, such as phosphor-tin, boron, magnesium, etc., is much more effectively carried out under the direction of a chemist, who, as before stated, makes a special study of the action of these fluxes on the metals. I am convinced that the employment of a chemist or foundry chemical engineer in a foundry of any size soon pays a handsome dividend on his salary.

## The Melting Point in its Relation to Alloying Capacity.

The opinion is often expressed that if a metal has a high melting point it is difficult to produce with it an alloy of uniform composition. Writing in "Metallurgical and Chemical Engineering," however, Dr. Hans Goldschmidt holds this opinion to be unwarranted. Practice, he adds, has long shown that carbon-free chromium, in spite of its melting point of 1550 deg. C. (2822 deg. Fahr.) alloys easily with molten steel. The same is true for carbon-free manganese with a melting point of 1245 deg. C. (2273 deg. Fahr.) and this manganese alloys especially easily with copper; in fact, more easily than manganese containing carbon. In recent years titanium is often added to steel. Ferrotitanium made for this purpose by the aluminothermic process has a melting point of 1330 deg. C. (2426 deg. Fahr.) and alloys easily with liquid steel. An alloy is nothing but a solution. For instance, an alloy of zinc and copper is called a "solid solution." Zinc has a melting point of 419 deg. C. (786 deg. Fahr.), copper a melting point of 1098 deg. C. (2008 deg. Fahr.). If we try to alloy lead instead of zinc with copper, we find that lead has a melting point of 330 deg. C. (626 deg. Fahr.), much lower than zinc, yet efforts to produce an alloy of copper and lead are not successful. It is simply a fact that lead does not dissolve in copper. Among the most refractory metals known we have platinum with a melting point of 1775 deg. C. (3227 deg. Fahr.). Yet platinum alloys with tin and lead at a temperature of the melting points of these two metals. The fact is simply that the high melting point of platinum does not protect the crucible from the dissolving action of the metals mentioned. From what has been said it is clear that for their practical purposes metallurgists have simply to take care that they employ metals or alloys which will dissolve. And it may become necessary to use intermediary alloys which dissolve more easily in the metallic bath. For instance, a high-percentage manganese-copper alloy is made from pure manganese, while instead of pure titanium ferrotitanium is used. This carbon-free ferrotitanium, containing 25 per cent. of titanium, is used now quite extensively as an addition to steel for making rails and rolls. This ferrotitanium made by the aluminothermic process dissolves very easily and uniformly in the molten steel. It has a small intentional content of aluminium, as this increases its solubility. The experience of metallurgists has shown that as a rule carbon-free metals dissolve more easily than metals containing carbon, since the latter contain carbides—that is, chemical compounds with carbon.

# Mechanical Equipment for Charging Cupolas.*

By G. R. Bandon.

Disregarding the primitive methods, still occasionally employed, of using barrows, and dumping stock on to the charging floor to be handled in making up charges, and again for charging into the cupola, the author will briefly review various modern methods of handling cupola stock from yard to cupola. Charges should be collected on cars, the proper amount of different grades being selected and weighed, and not again handled until introduced into the cupola. Cars of two tons' capacity, properly constructed and equipped with roller bearings, can easily be pushed over level tracks by one man. When warranted by conditions, an electrically-operated transfer car may be used to transport charging cars while charges are being collected. A scale may be mounted on a transfer to weigh the charges, if desired. After the charges are weighed, the cars are elevated to the charging platform by means of an elevator, or if the yard crane is available, cars may be constructed with means for attaching slings, and the car with charges lifted intact to the charging floor; but this latter method is not an economical one and is only permissible in case of accident to the elevator. Iron and scrap may be elevated to the charging floor with a magnet crane, but this method requires additional space on the charging floor and involves extra handling.

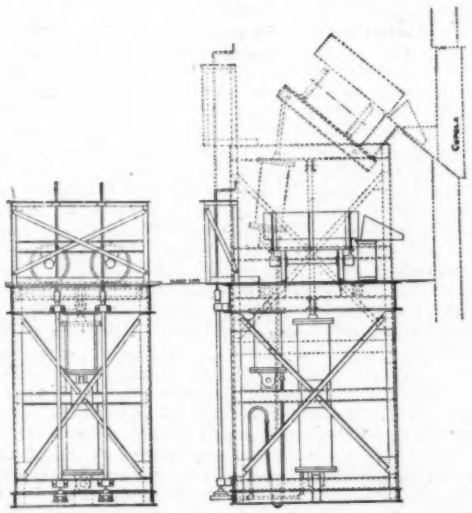


FIG. 1.—COMPOUND CUPOLA CHARGING MACHINE IN NORMAL AND DUMPING POSITIONS; POWER FURNISHED BY PNEUMATIC CYLINDER HOIST.

Storage space for about 50 per cent. of the metal for one heat should be provided for on the charging floor and a sufficient number of cars to carry this stock must be supplied for convenience and economical operation. As soon as emptied, cars are lowered to the yard and charges replenished for a later period in the heat. A system of tracks on the charging floor should provide for the constant forward travel of cars, and an open track to the elevator for cars that have been unloaded.

If desired, cars may be provided with flat-tread wheels, suitable for a plate floor, or with combination wheels, which may be used both on the track and the plate floor. A special design, of American origin, has a platform overhanging at one end, so that when the load is properly adjusted, it will almost balance on one axle. By means of a handle at the other end of the car, it may be readily turned and pushed in any direction. When proper arrangements are made, charges may be dumped into the cupola from this car. It is backed up to the charging door, the wheels are blocked and the forward end is lifted by a suitable hoist. The skip car operating on an incline, with automatic dumping device, is also used for charging cupolas.

Another device consists of a trolley operating on the jib of a crane or on a track which extends into the cupola. Charges are made up as desired in a cylindrical bucket, with drop-bottom doors, which is carried on this trolley. Hoisting and trolley-travel movements are operated by power, and the drop doors are opened by releasing a latch.

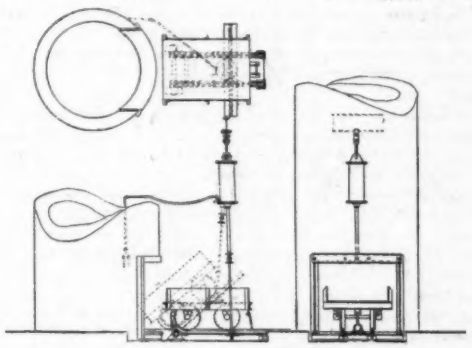


FIG. 2.—END DUMP CUPOLA CHARGING MACHINE.

The Whiting charging machine is used in connection with a simple design of car having steel plate ends, about 12 ins. high, for iron charges, and is provided with a plate body with a swinging side door, hinged at the top, for coke. On the side-dump machines, cars are pushed on to a hinged platform, locked with a simple hook which engages a loop on the car frame, the platform and car are raised together by power, and the charge dumped. The distribution is under the perfect control of the operator, the charges being delivered to the opposite side of the cupola by a sudden, and to the near side by a slow, hoisting movement. End-dump machines are supplied when conditions require it, but side-dump cars are preferred, as the cars do not have to be turned to place them on the machine. Fig. 2 illustrates an end-dump machine.

### Large Charging Machines.

Fig. 1 shows a compound charging machine in normal and dumping positions. A pneumatic-cylinder hoist furnishes the power for this machine. An

* Abstract of Paper read before the American Foundrymen's Association.

electric geared hoist may be substituted for the pneumatic hoist. On the electric compound machine only one hoisting mechanism is required, as the design provides for the inclination of the platform without an independent hoist. A crane type of controller is used, which permits wide ranges of speeds and insures a uniform distribution of the charges. Fig. 3 shows side and end elevations of an electric compound charging machine. The charging door in the cupola, used in connection with the charging machine, is larger than the ordinary door for hand charging and is set lower. An inclined shute is arranged to receive the stock as it is dumped from the car. The charging machine is provided with an apron plate, which overlaps the shute and prevents the iron from dropping from the car to the floor. A vertical distance of four or five feet between the top of the stock in the cupola and the sill of the charging doors is necessary to provide space for the distribution of the charges. Therefore, the charging floors should be higher than when charging is done by hand.

These machines have an hourly capacity of 10 to

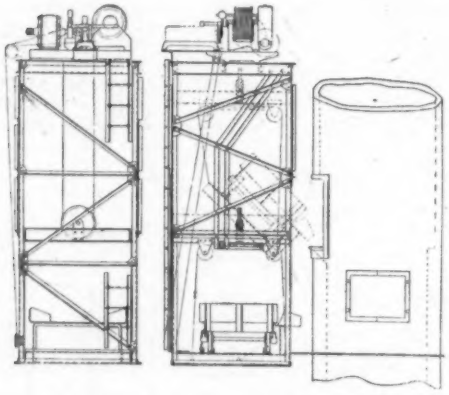


FIG. 3.—ELECTRICALLY-DRIVEN COMPOUND CUPOLA CHARGING MACHINE.

15 tons or more, the economy of operation increasing as the output per hour increases. For a cupola melting 20 tons per hour, two men with a charging machine attend to all the charging operations, where otherwise five or six men would be required. Another advantage of this machine is that its location is fixed in relation to the charging door and conditions of operation are always uniform. The cost of installation is small, much less, in fact, than the extra cost of cars with hinged bodies would be for any moderate size of plant. Charging cars only are required, and they are of design that can be used for ordinary hand charging.

## Machine versus Hand Moulding.*

BY JOHN ALEXANDER.

Amongst the many mechanical appliances that have been invented for the foundry trade, the moulding machine covers the largest field as far as output and economy is concerned, and is the greatest help in these days when moulders seem to be getting scarcer. However, before we undertake to purchase a moulding machine, let us look into a few of the details connected therewith. First of all, there is no reason why we should expect one kind of a machine to do all of our work, any more than does the machinist who has a number of different machines to do his work. Above all, do not think for a moment that we are going to run our foundries with machines and unskilled help—we need the moulders, and it would be to their advantage as well as all others concerned if they would take more interest in machine moulding.

Now, as to what kind of a machine should be purchased, that should be determined by oneself. It is right and proper to get the advice of responsible machine manufacturers, but go and visit a few foundries that have machines and are making a class of work something similar to what you want to make. At the same time do not forget to think out how many different things you could make on a certain machine if you had it. Many a time you may wish you had a "squeezer," when by probably doubling up or by putting eight patterns on a board instead of two, you could do much bettter on a roll-over machine, and *vice versa*. It is the number of castings you have to make, combined with the different kinds of castings you can make on a certain machine, along with the cost of operating same, that should determine which to purchase.

It would be useless to try and enumerate all of the different kinds of machines on the market at the present time. Some are better suited than others for certain classes of work, and it is for the individual buyer to see that he gets what is necessary for his requirements. In taking up a few of the more commonly used machines that I have seen in daily operation in over fifty different foundries, I found that foundrymen were having a gain of from 50 to over 250 per cent. over hand methods in making moulds and half-moulds weighing from 50 to 50,000 lbs. The percentage of bad work is reduced to a minimum; so that when we compare the money investments on machines, the enormous gains soon pay for them. In my investigations relative to the repairs on machines when they get out of order, I have found that the cost is very small, and in quite a number of cases some machines have been in constant use for one, two and three years, and have practically cost their users nothing for upkeep.

### Mounting Patterns for Machines.

A great deal could be said about this subject, but every foundry has its own conditions to contend with, and the question depends largely on the number of castings of any one kind to be made, the size and weight of same.

On the smaller machines, wood boards for mounting patterns permanently can be used to advantage, particularly on roll-over machines, as they are light to handle and cost considerably less than the brass or iron plate with dowel holes to match different patterns. There will be less fins, and castings will be more accurate. As to stripping plates or frames, it is almost necessary to have them made in brass or iron with edges filled in with babbitt metal, although quite a number of wood plates or frames are used.

As to matches, the old sand match still holds its own, although there are a number of different compositions on the market now that are giving satisfactory results. On the larger machines, the wood follow-board is used very extensively, although some of the jarring machines are equipped with iron plates, the same having dowel holes to match a certain number of patterns and flasks to suit. Some again are

* Abstract of Paper read before the American Foundrymen's Convention, May, 1911.

equipped with stripping plates, which, as we all know, are a great advantage. I believe the jarring machine will be the machine of the future for general work.

The more automatic machines are in a class by themselves and no doubt give an enormous and satisfactory output where they can be installed. Castings moulded on machines are more near uniform to pattern, at least from 10 to 15 per cent. in their weight is saved, and through the accuracy of the work not less than 5 to 10 per cent. of time in finishing in the machine shop is saved. The life of the patterns, also, is increased tenfold, as there is little chance of the deadly vent wire, rapping bar and sledge hammer, or swabbing destroying them.

## Effect of Repeated Melting on Manganese Bronze.*

By Jesse L. Jones.

The smooth, clean surface, the beautiful golden colour, and also the mechanical strength of manganese bronze castings, depend largely on the manner in which the ingot metal is melted. The following analysis may be regarded as typical of this alloy:—Aluminium, 0.14 per cent.; copper, 56.57 per cent.; iron, 1.50 per cent.; lead, 0.01 per cent.; manganese, 0.07 per cent.; tin, 1.21 per cent.; zinc, 40.50 per cent.

In order that the above proportions may be as little changed as possible, the melting operations should be done quickly. If an oil-fired furnace is used, the time for melting a 500-lb. heat should not exceed 15 or 20 minutes, and the surface of the metal should be well protected. When melting in crucibles a longer period is required, but it should be as short as possible, and the metal should be kept well covered with charcoal. If the melting operation is unduly prolonged considerable zinc is volatilised, and for this reason makers of the ingot metal advise brassfounders to add 2 lbs. of zinc to each 100 lbs. of remelted bronze. The iron content of the alloy is supposed to be protected from oxidation by the aluminium and manganese present, but as these metals are present only in small quantities the extent of the protection they afford is rather limited.

When the iron becomes oxidised, castings made from the metal have a rough, black surface, and the tensile strength and ductility are much lowered. But if the oxidation has not gone so far as to produce castings with a blackened surface, it may show in a coarse-grained metal, full of lemon-coloured spots, which will also be weak and brittle. While it is possible to replace the zinc and aluminium lost by volatilisation, it is more difficult to replace the iron and manganese because of their high melting points. The removal of the entangled or dissolved oxides of iron, copper, etc., has also to be effected if the original ductility of manganese bronze is to be restored after oxidation has occurred. Hence it is better policy to prevent deterioration than to try to doctor the metal after it is spoiled. To make a practical trial of the effects of repeated melting of manganese bronze, a number of tests were made, the results of which are given in Tables I. and II. Heats were run in both crucible and open-flame furnaces, and ingot metal was used because of its uniform character.

The metal charged was weighed carefully, but no special care was observed in melting, as it was done in the usual routine manner. The metal was made quite hot, as required for pouring small castings, and was run into ingots and test bars. The ingots, minus the weight of the test bars and the melting loss, were then charged again and remelted in each successive heat. No deduction was made for shot metal in the skimmings, nor any metal that splashed on the floor while pouring, or adhered as skulls to the walls of the crucible or furnace. All losses were included in the melting loss, only the clean ingots and test bars being considered. That no unusual care was taken to keep the melting loss low is indicated by the loss in crucible heat No. 1, Table I., and no additions were made to any heat except No. 7.

The repeated melting of manganese bronze gradually lowers the ultimate strength, elastic limit, electrical conductivity, and hardness of the metal. The ductility is not affected to any great extent, as shown by the elongation and reduction of area. The addition of zinc, etc., to remelted manganese bronze is not advisable.

* Abstract of Paper read before the American Brass Founders' Association, at Pittsburg Convention, May, 1911.

Table I.
*Crucible Heats.*

| Heat number. | Metal charged, lbs. | Ingots obtained, lbs. | Loss in lbs. | Loss per cent. |
|---|---|---|---|---|
| 1 | 243½ | 216 | 27½ | 11.34 |
| 2 | 203 | 192 | 11 | 5.41 |
| 3 | 179 | 171½ | 7½ | 4.19 |
| 4 | 159 | 153 | 6 | 3.77 |
| 5 | 146 | 141 | 5 | 3.48 |
| 6 | 134½ | 130 | 4½ | 3.34 |
| 7 | 124 | Additions | were made | to this heat. |

*Results of Physical Tests.*

| Heat number. | Ultimate strength, lbs. per square inch. | Elongation in 2 in., per cent. | Reduction of area, per cent. | Conductivity. | Hardness (Shore). |
|---|---|---|---|---|---|
| 1 | 76,850 | 22.5 | 21.5 | 24.10 | 23.3 |
| 2 | 69,700 | 43.0 | 51.0 | 21.75 | 19.4 |
| 3 | 66,750 | 45.0 | 55.0 | 20.82 | 19.0 |
| 4 | 60,950 | 44.0 | 54.0 | 20.82 | 18.6 |
| 5 | 62,450 | 36.0 | 32.5 | 20.07 | 17.8 |
| 6 | 62,200 | 36.0 | 29.5 | 20.07 | 18.4 |
| 7 | 69,950 | 37.5 | 37.5 | 21.57 | 18.4 |

Table II.
*Open Flame Furnace Heats.*

| Heat number. | Metal charged, lbs. | Ingots obtained, lbs. | Loss in lbs. | Loss per cent. |
|---|---|---|---|---|
| 1 | 985½ | 949 | 36½ | 3.72 |
| 2 | 926 | 856 | 70 | 7.56 |
| 3 | 845 | 819 | 26 | 3.07 |
| 4 | 796 | 768 | 28 | 3.51 |
| 5 | 742½ | 715 | 27½ | 3.70 |
| 6 | 700½ | 680 | 20½ | 2.92 |
| 7 | 660 | 630½ | 29½ | 4.47 |
| 8 | 616 | 590½ | 25½ | 4.14 |

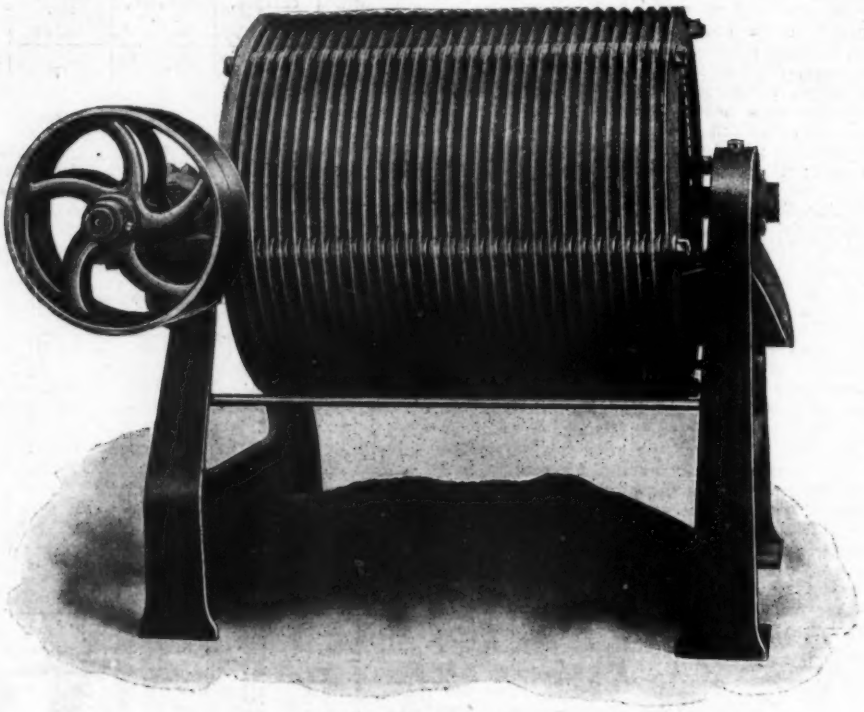
*Results of Physical Tests.*

| Heat number. | Ultimate strength, lbs. per square inch. | Elongation in 2 in., per cent. | Reduction of area, per cent. | Conductivity. | Hardness (Shore). |
|---|---|---|---|---|---|
| 1 | 74,850 | 31.0 | 29.0 | 24.50 | 20.8 |
| 2 | 71,000 | 31.5 | 28.5 | 24.00 | 20.2 |
| 3 | 66,800 | 42.0 | 45.0 | 22.55 | 19.8 |
| 4 | 67,750 | 38.0 | 55.2 | 22.52 | 18.4 |
| 5 | 68,050 | 45.0 | 54.5 | 22.92 | 18.4 |
| 6 | 64,650 | 49.0 | 55.0 | 22.00 | 18.8 |
| 7 | 61,500 | 35.0 | 27.5 | 21.12 | 18.4 |
| 8 | 69,650 | 34.5 | 27.5 | 21.12 | 18.2 |

# Foundry Plant and Equipment.

## A New Sand Riddler and Mixer.

There has recently been placed on the market a new sand riddler and mixer for foundry purposes. This appears to be a very useful and simple piece of machinery, all unnecessary parts having been dispensed with. It is strongly built to withstand the rough usage which machinery of this nature often receives at the hands of foundry labourers. The illustration gives a good idea of its general appearance. It consists primarily of two end standards supporting a steel shaft, to which is fixed a revolving drum made of a series of rings of a suitable section with a space between each, a number of loose cast-iron stars placed in the drum, bevel gear for driving, and the necessary belt pulleys.



NEW SAND RIDDLER AND MIXER.

The sand to be treated is fed into the drum, when revolving, at one end of the machine. The action of the drum and stars is to thoroughly pulverise and mix the sand to the required consistency, after which the latter is then automatically discharged through the small spaces between the rings. Pieces of metal or other foreign material are retained in the drum, and removed when convenient. The mesh of the machine can be arranged to suit the different types of sand used, *e.g.*, green sand, facing sand, hard-milled sand, etc., those at present in use being $\frac{1}{16}$ in., $\frac{1}{8}$ in. and $\frac{3}{16}$ in.

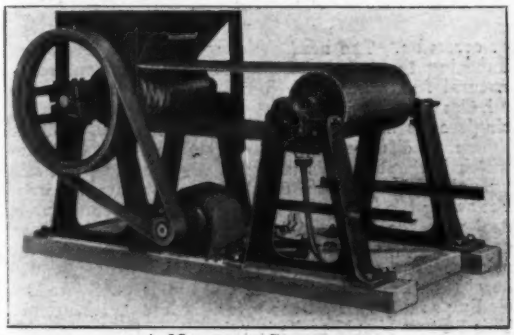
Some of the advantages claimed for this machine are as follows:—All kinds of sand can be treated by the apparatus, which thoroughly pulverises, mixes and aerates the sand and brings it to a light condition; pieces of metal and other foreign materials are separated; the design is simple and substantial, and without parts liable to get out of order or wear out rapidly; as there are no fast speeds, little power is required, with the result that the cost of driving is infinitesimal.

The patentees and manufacturers, Messrs. J. W. & C. J. Phillips, Limited, 23, College Hill, Cannon Street, London, inform us that the machine is the result of a series of exhaustive experiments extending over a period of several years. The experiments were carried out in a large iron foundry, and the working of the experimental machine was the only means by which the supply of prepared sand was maintained. The result is a substantial and practical working machine, capable of turning out two tons per hour with ease. A number of these machines have already been installed in some of the largest foundries in this country, and are, we understand, giving entire satisfaction to all concerned.

## Magnetic Separator for Iron and Steel.

A magnetic separator, built by the Cutler-Hammer Manufacturing Company, Milwaukee, U.S.A., which is designed to remove large pieces of iron or steel from

ore, coal or rock that is to be passed through crushers is shown herewith. The application of this apparatus in the foundry is extensive; it can be used for the removal of shot and small particles of iron from moulding sand and for the separation of brass chips from machine shop turnings. When installed, a chute or other conveyor is placed underneath the magnetic pulley, into which the magnetic material is dropped. The non-magnetic material is projected some distance in front of the pulley, thereby effecting clean separation. The pulley at the head in the illustration, consists of alternate coils and steel discs concentric with the shaft, the coils being wound on steel spools doweled to the discs, which are in turn keyed to the shaft. Each coil is enclosed and protected by a cylindrical brass coil shield, which is attached to each of the two adjacent poles. Current for the coils is obtained through carbon brushes held on a pair of slip rings by self-adjusting holders.



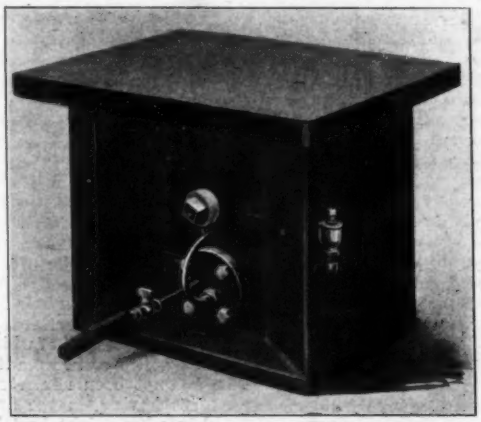
A MAGNETIC SEPARATOR.

The material to be separated is fed through a hopper to the conveyor belt, by means of which it is passed over the magnetised pulley; the magnetic matter is drawn towards the face of the pulley, clinging to the belt up to the point at which the belt leaves the pulley at the lower side. At this point it is snapped off into the chute or other conveyor provided. These pulleys are built in lengths from 16 to 36 inches, and are 12 inches in diameter. The current consumed varies from 325 to 750 kilowatts and the capacities range from 1,340 to 3,000 cubic feet per hour. The pulleys are designed to operate on any direct-current voltage up to 250.

## Core-Bench Jolt Rammer.

An unusual application of the jolt rammer is depicted herewith. It has well been known that jolt ramming of large cores, even when filled with rods, coke centres, etc., is economical, and for deep cores of small dimensions made on the bench, the ramming, including the bedding in of reinforcing rods or wires can be better and more cheaply done on a small jolt ramming machine. The Mumford Molding Machine Company, Plainfield, N.J., U.S.A., has recently developed a machine of this type, shown in the illustration, which can be placed on a concrete pier, iron or wooden post or mounted on the core bench.

The machine is started and stopped by a knee valve under the bench, an arrangement which leaves the operator with both hands free to manipulate material and core boxes. The valve is constructed to all intents and purposes the same as a valveless plunger, and is merely a plug of case-hardened machinery steel having a vertical stroke of 3/16 in. Although this construction is very simple, at the same time it is claimed that the economy in air secured by its use is greater than that of the more elaborate valve mechanisms used on this type of machine.

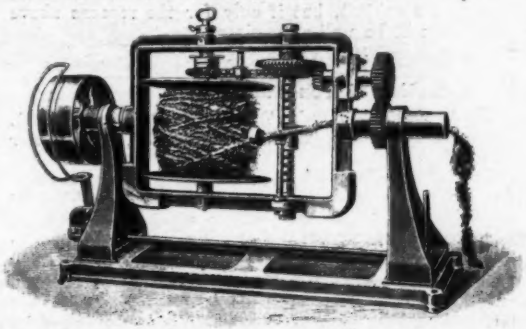


MUMFORD CORE-BENCH JOLT RAMMER.

The size of the table is 15 by 20 in. and the diameter of the plunger is 3 in. Although the rated capacity of the machine is 300 lb. with an 80 lb. air pressure, the advantages when used on small cores where the core boxes, sand and reinforcing material weigh only a few pounds are said to be very great. The complete apparatus weighs 325 lbs.

## Hay-Band Spinning Machine.

A useful apparatus for founders who are employing hay-band to a considerable amount is shown herewith. In addition to the economy of time and labour secured by its use, it effects a great improvement in the quality of the bands over those made by hand, and by suitably proportioning the speed of the feed rollers and the revolutions of the frame, bands of any degree of hardness or softness may be produced.



HAY-BAND SPINNING MACHINE.

Two important factors of utility in this machine are its strength and the simplicity of its mechanical arrangements. It is not liable to get out of order, and is very rapid and effective in action. A labourer can attend to it after a little practice and can, without assistance spin 400 yds. per hour. The makers are Messrs James Evans & Company, Blackfriars, Manchester.

## "F.T.J." Bookshelf.

### Iron and Steel: Their Production and Manufacture.

*By Christopher Hood. London: Sir Isaac Pitman and Sons, Ltd., 1 Amen Corner, E.C.*

This little book forms one of the series, "Pitman's Common Commodities of Commerce," and if it may be taken as typical of the series, the publishers are to be congratulated. The author (of the firm of Messrs. Bell Bros., Ltd.) has struck a line somewhat different to any other book of its kind that we remember; it is neither a technical handbook nor a commercial essay, but a judicious mixture of just sufficient of each to make a really useful educational work. Iron from its hypothetical origin is taken through its various processes until it emerges as finished iron and steel, castings, etc., but only sufficient details of the various processes are presented to give a clear and concise survey of the development of the metallurgy of iron to its present state. Such a survey, naturally, necessitates numerous historical references, all of which add brightness to the work, while at the same time the economic side of the question has not been neglected. The technical side of the subject having, in the first half of the book, been treated in what might best be described as an excellent summary of the origin and development of iron and steel-making processes, the question of trade in iron is taken up. Here the author is obviously on ground with which he is familiar, for after a brief survey of the history of the trade, so far as it is known, from Tubal Cain's time until recent years, its progress during the last 200 years or so is more fully discussed. The respective positions in the trade of Germany, the United States, France, Belgium, and other countries, are each in turn considered, and then the author proceeds to a description of the origin and working of the warrant market. Protective policies, etc., are then discussed, and the volume concludes with statistics of production, etc. The book is unpretentious in size and style, but it fills a gap among our educational works, in that it links up into one concrete scheme the technical and the commercial sides of the iron trade, showing in a few words how the great iron and steel industry has evolved from its early and obscure state. The size of the book precludes detailed treatment, particularly of the technical side of the subject, but if only for the reasons above cited, it will be well appreciated.

### The Corrosion of Iron and Steel.

*By J. Newton Friend, Ph.D. (Würz), D.Sc. (B'ham). London: Longmans, Green and Co., 39, Paternoster Row, E.C.*

If anywhere in the field of metallurgy there is scope for extensive research work, it is on the subject of corrosion. It is the one problem which has always to be faced, whatever branch of engineering is touched; and while metallurgist and steel-maker may successfully unite to meet stricter strength requirements in the metal, they must eventually come up against the corrosion problem. So long as metals are employed for the purposes of civilisation, so long, probably, will the problem be present, by reason of the never-ceasing tendency of matter to form new combinations or to revert to the elemental condition. But it is, of course, quite possible to obtain compounds for which all practicable purposes are stable, and science has, accordingly, for years been attempting to ascertain and tabulate the conditions under which iron and steel tend to corrode, and to also overcome this tendency. A vast amount of research work has been done by numerous investigators, but much of it has overlapped, resulting from lack of systematic records. In this way, no doubt, much valuable work has been wasted through duplication, while the investigators themselves have gone unassisted by what might have materially aided them. On account of these considerations, the author of this book has set himself to review all the reliable work done on the subject of corrosion, and to present it in a consolidated form. The task has, without question, been no light one, but the result is certainly a very valuable work. As illustrating the ground covered in the book, we cannot do better than enumerate the subjects as classified. The opening chapter is devoted to iron, its history and value, this being purely introductory in character. The action of air and water, and the action of steam, respectively, on iron are separately discussed; various theories of corrosion are then summarised, and the question of whether an acid is essential to corrosion is considered, the author concluding that such is the case, though in rejecting the electrolytic theory of corrosion he explains that the electrolytic theory of ionisation is not also to be excluded in the explanations to the various phenomena of corrosion. The next chapter deals with factors influencing the rate of corrosion of iron exposed to natural forces, after which the action of acids and of alkalies are treated. The influence of solutions of single salts and of solutions of electrolytes, and the action of oils upon iron are further subjects, after which a chapter deals with the oft-discussed, but still unexplained, question of the passive state of iron. Following the foregoing, the concluding three chapters deal with the influence of chemical composition upon corrodibility, electrical and galvanic action, and the relative rate of corrosion of iron and steel. It will be observed that the ground covered is extensive, including at any rate all the principal known researches. This feature should make it valuable to future investigators, enabling them to proceed from those points already established.

ALLDAYS AND ONIONS PNEUMATIC ENGINEERING COMPANY, LIMITED, GREAT WESTERN WORKS, BIRMINGHAM.—We have received from this firm illustrated catalogues "M.T." and "M," the former dealing with manufactures applicable to the motor and cycle trade, and the latter with pneumatic power forging hammers, drop stamps, and levers, etc.

## Query.

### Cast-Iron Pump Plungers.

We have to cast some iron pump plungers 12 in. diameter by 30-in. long by $\frac{7}{8}$ in. thickness of metal, in a chill. We shall be glad of any information that will assist us in obtaining a smooth external surface. The pouring is done from the top, and the chill is heated before casting the plunger to a temperature greater than can be done by the bare hand. The castings come out fairly clean for about 1 ft. up, but above that, they are full of small holes and shots. We have also cast these with $1\frac{1}{4}$ in. thickness of metal, but the result is the same.

"H."

THE NEW HAVEN SAND-BLAST BARREL.—In our issue of June last, on page 349, we published a description of the New Haven Sand-Blast Barrel. This apparatus, we neglected to state, is being manufactured in this country by Messrs. Vickers, Limited, whose London offices are Vickers House, Broadway, Westminster, S.W.

# Inventions.

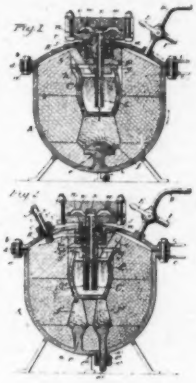
## Applications for Patents.

An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

13,955. Moulding-machines. W. E. Martin.
13,960.*Casting-machines. J. Sosa.
14,027.*Appliance for charging and emptying metallurgical furnaces. E. Gottlieb.
14,277.Gas-heated furnaces. J. Wing, Jun., and J. R. Burnett.
14,568. Casting metals and metallic alloys. J. S. Critchley and H. A. A. Dombrain.
14,791. Moulding-machines. A. Phillips.
15,173. Furnaces for heating, puddling, smelting, calcining, etc. A. Smallwood.
15,181.*Extraction of compounds of vanadium, molybdenum, tungsten, etc. A. H. Perret.
15,459.*Furnaces. G. Wilton.
15,521. Furnaces. George Fletcher & Company, Limited, and F. P. Rudder.
15,555.*Process for hardening steel castings. J. W. Gebhard.
15,683. Machines for grinding drills and tools. (Engels & Waegner, Germany).
15,740.*Metallic alloy. J. F. Duke.
15,824. Production of metals from their ores. J. Härden & Electric Furnaces & Smelters, Limited.
15,855. Core-making machine. H. B. Stocks.
16,182. Production of cast metal hinges of which numbers are moulded at a time. Thomas Holcroft & Sons, Limited, and A. Holcroft.
16,183. Production of metal castings. Thomas Holcroft & Sons, Limited, and A. Holcroft.

## Abstracts of British Patent Specifications recently accepted.

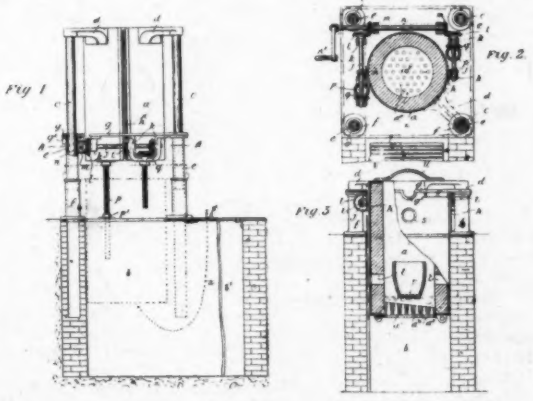
13,304 (1910). *Casting Metals of High Melting Point.* A. L. J. Queneau, 6015, Overbrook Avenue, Philadelphia, U.S.A.—The invention relates to a method of casting metals in moulds and to an electrical casting furnace adapted to produce finished castings from metals which melt at high temperatures, such as brass, phosphor bronze, manganese steel and the like, and has reference to that kind in which air or gas under pressure is employed for forcing the molten metal, which is maintained in a liquid condition and at the regulated temperature in a suitable receptacle by means of an electric current passing through electrodes arranged in the casing, into the mould. The casting metal is maintained in a liquid condition and at the requisite high temperature by the heating effects of an electric current, and the casting nozzle which introduces the metal into the mould is heated by electricity in a similar manner. The characteristic feature of the invention consists in the fact that the nozzle is a "dip nozzle," *i.e.*, one which projects or depends in to the molten metal in the container, so that when an appropriate fluid pressure is applied to the surface of the molten metal the latter is raised into the mould, such pressure being continued until the mould is filled and the casting therein has sufficiently set. To enable the above-mentioned operation to be carried out, especially when dealing with aluminium-bronze, manganese-bronze and the like, it is necessary to maintain the dip nozzle at a very high temperature, even higher than the fusion point of the casting metal itself, so that as soon as the metal has passed into the mould and completely filled the same, the metal in the nozzle will still be in a molten condition up to the gate of the mould; consequently, when the air pressure is withdrawn or diminished, as soon as the mould has become filled, the surplus metal remaining in the nozzle is free to drop back into the receptacle containing the main body portion. Further features of the invention consist in various features of construction, incident to its practice, and which have application generally to furnaces which may be designed to operate upon the same fundamental principles. In the accompanying drawings Fig. 1 represents in vertical section one form or modification of an electric furnace and its adjuncts for the practice of the



ELECTRIC CASTING FURNACE, BY QUENEAU.

invention, and Fig. 2 represents a like view of another form or modification thereof.

16,511 (1910). *Furnaces for Melting Metals.* H. J. Mundy, 3, Westmorland Street, Hull, Yorkshire.—The object is to provide a furnace which can be quickly and conveniently converted from a shaft or cupola furnace into a crucible furnace. The invention comprises a furnace or combustion chamber adapted to be raised or lowered, said chamber having means whereby, when in the raised position, it may be employed as a shaft or cupola furnace, and when in the lowered position as an ordinary crucible furnace. Fig. 1 is an elevation showing the furnace in the raised position for melting iron, Fig. 2 is a sectional plan on line A A of Fig. 1, and Fig. 3 is a sectional elevation at right angles to Fig. 1,



FURNACE FOR METALS, BY MUNDY.

the furnace being in the lowered position. In the drawing *a* is a furnace chamber lined with fire brick, *b* is a well formed below the ground level, within which the furnace *a* is adapted to be raised or lowered, and the said well *b* is extended to one side of the furnace as at $b^1$ in Figs. 1 and 2, which extension is provided at the ground level with a grid $b^2$. c c are vertical

guide rods, the upper ends of which are secured to lugs *d d* on the furnace *a*, while the lower ends of the rods *e* are adapted to telescope within sleeves *e e*, which in turn slide in fixed guides or pedestals *f f*. *g* is a platform upon which the lowering and raising mechanism is mounted, the said platform being secured to the upper ends of the sleeves *e e*. *h h* are racks disposed on either side of the chamber *a* and adapted to be engaged by the pinions *i i* mounted on side shafts *j j*. These shafts rotate in bearings *k* carried on the underside of the platform *g*, and the shafts carry at one end bevel wheels *l l*, which are engaged by bevel wheels *m m* mounted on the operating shaft *n*, having a handle $n^1$. In order that the platform with the operating mechanism may also be raised a suitable distance so as to leave the lower end of the chamber *a* free when in the raised position, screw packs *p p*, one on either side, work in nuts $p^1$ $p^1$ and rotate by bevel gear *q* from the side shafts *j j*. The platform *g* is provided with a depression or lip $g^1$ adapted, when the furnace is in the raised position, to come opposite the usual pouring or tapping hole *r*. The furnace *a* is provided with a removable bottom $a^1$ perforated as at $a^0$, which is supported by a hinged base $a^2$, and a flue *s* is also provided for use when the apparatus is in position for melting brass. *t t* are apertures formed on opposite sides of the furnace into which the tuyere or blast pipe (not shown) is adapted to be inserted to supply the blast when the furnace is in raised position for melting iron.

## Personal.

MR. A. E. KNIGHT has been appointed works manager for Boulton & Paul, Limited, Norwich.

THE gross value of the estate of the late Mr. A. Brash, of the Chatteris Engineering Works, is £14,547.

THE late Mr. J. Brown, brassfounder, of Almshouse Lane, Wakefield, left estate valued at £8,953.

THE degree of Doctor of Metallurgy has been conferred upon Sir Robert Hadfield by Sheffield University.

THE freedom of the city of Birmingham was conferred upon Mr. Jesse Collings, M.P., and Mr. William Kenrick, on July 19th.

MR. T. H. GARDNER, of Gardner & Sons, Limited, Barton Hall Engineering Works, Patricroft, has been made a J.P. for Eccles.

THE late Mr. R. Parker, a director of Guest, Keen & Nettlefolds, Limited, left estate of the gross value of £20,295, with net personalty £20,174.

THE late Mr. J. J. Muxlow, a director of Muxlow & Knott, Limited, Hope Steel Works, Sheffield, left estate valued at £16,968 gross, with net personalty £8,579.

THE late Mr. A. J. Gimson, a director of Gimson & Company (Leicester), Limited, left estate of the gross value of £43,404, of which the net personalty has been sworn at £27,276.

MR. A. E. BREWER, works manager for the Railway and General Engineering Company, Limited, Nottingham, has been appointed general manager of John Bellamy, Limited, Millwall.

MR. J. J. STEINITZ, formerly connected with the Brush Electrical Engineering Company, Limited, of Loughborough, has been appointed general manager of the Gloucester Railway Carriage and Wagon Company, Limited, of Gloucester.

AT a Board meeting held on July 5 at the Brightside Works, Sheffield, of William Jessop & Sons, Limited, Mr. W. H. Thomas, who has been connected with the company for 20 years, was elected a director in place of the late Mr. E. H. Linley.

MR. H. WALLIS, who recently retired from the board of the Birmingham Small Arms Company, Limited, after 45 years' service as secretary, manager and managing-director, has been the recipient of a presentation from the members of the old B.S.A. staff.

## Trade Talk.

ACER, LIMITED, of Hanwell, have transferred their business to the Leaborne Works, Harrow.

THE business of Mr. Marcus Allen has been removed to the Vernon Engineering Works, Elsinore Road, Old Trafford, Manchester.

THE MANGANESE BRONZE AND BRASS COMPANY, LIMITED, have removed to Rooms 210, 211, 212, Caxton House, Westminster, London, S.W.

MESSRS. JOHN WILLIAMS & COMPANY, of Wishaw, have appointed Mr. H. B. Sparrow, of 65, Fenchurch Street, E.C., as their sole agent in London.

A WINDING-UP order was recently made at the Leeds Bankruptcy Courts against the Bosshardt Casting Process, Limited, of Cabinet Chambers, Basinghall Street, Leeds.

E. CAPPER ROBSON & COMPANY, LIMITED, 1, North Road, Darlington, have been appointed selling agents for Thwaites Brothers, Limited, Vulcan Iron Works, Bradford.

JOHN DAVIS & SON (DERBY), LIMITED, of the All Saints' Works, Derby, have recently doubled the capacity of their foundry for casting brass, gun-metal, and aluminium.

MESSRS. J. WARDELL & COMPANY, Westminster Chambers, 9, Victoria Street, S.W., have removed to Westminster Chambers, 3, Victoria Street, Westminster, S.W.

MR. E. J. CROSIER, engineer and merchant, trading under the style of Crosier, Stephens & Company, 2, Colingwood Street, Newcastle-on-Tyne, has been adjudged bankrupt.

J. KIRKWOOD, trading as James Kirkwood, The Foundry, Tranent, has suspended payment, and has granted a trust deed on behalf of his creditors in favour of Mr. W. Fraser, of Tranent.

On July 15th a fire occurred at the Etna Foundry, Gibson Terrace, Edinburgh, occupied by Messrs. Wishart & Black, ironfounders. The pattern shop and gas engine room roof were seriously damaged.

THE engineering works at Groveland, Tividale, which have been closed for some time, and were formerly owned by H. White, Limited, have been acquired by a Birmingham firm, and will shortly be re-started.

THE MOND NICKEL COMPANY, LIMITED, have made an issue, through Parr's Bank, of £250,000 5 per cent. first mortgage debenture stock at par, part of an authorised issue of £375,000, redeemable at £105.

MESSRS. W. W. WOOD and B. G. WOOD, carrying on business as merchants and manufacturers, at the Wardsend Steel Works, Sheffield, under the style of the Wardsend Steel Company, have dissolved partnership.

AT a recent meeting of the shareholders of Steel & Garland (1905), Limited, it was decided to wind up the company, Mr. B. Hadfield, of Priory Foundry, Worksop, the company's secretary, being appointed liquidator.

MR. G. C. CUNINGHAM, M.Inst.C.E., at one time general manager of the Central London Railway, has established himself in business in Finsbury Pavement House, Finsbury Pavement, London, E.C., as a consulting engineer.

AT a recent meeting of the shareholders of the British Bronze Company, Limited, it was decided to wind up the company voluntarily, Mr. A .W. Alexander, of Ingram Court, 167, Fenchurch Street, E.C., being appointed liquidator.

MESSRS. E. G. APPLEBY & COMPANY, of 10, Victoria Street, London, S.W., have, in addition to the Kerpely gas producer, taken up the sale of the Phœnix electro magnet, the Phœnix liquid controller and starter, and the Marston high-speed friction saw.

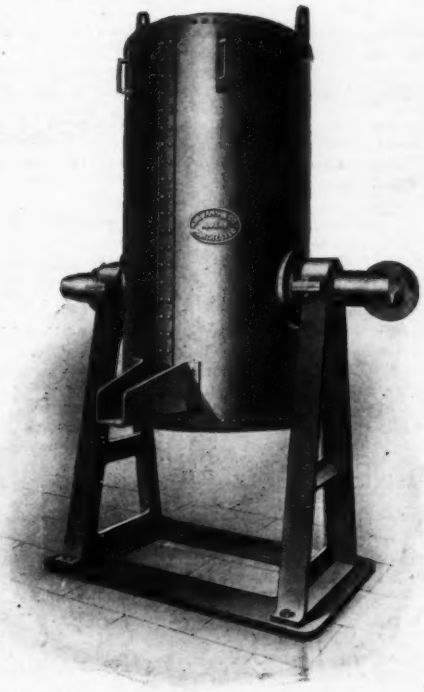
MR. G. H. HUGHES, M.I.Mech.E., engineer and works manager to Robert Warner & Company (Engineers), Limited, Walton-on-the-Naze, has resigned and started

AS SUPPLIED TO THE ADMIRALTY, WAR OFFICE,
COLONIES, AND FOREIGN GOVERNMENTS.

# THE Cupola.
# Evans's Rapid.

**Foundries Completely Furnished.**

## EVANS'S NEW CUPOLETTE
**For Emergency Work.**



**James Evans & Co.,**
Britannia Works,
*Blackfriars,*
*MANCHESTER.*

Telegrams: "LADLES, MANCHESTER."

business on his own account as a consulting engineer at 35, Queen Victoria Street, London, E.C.

THE shareholders of the Leeds Engineering and Hydraulic Company, Limited, of the Oaklands Engineering Works, Rodley, near Leeds, have decided to wind up the company voluntarily, and have appointed Mr. J. W. Hirst, 28A, East Parade, Leeds, as liquidator.

NOTICE is given, that the partnership hitherto subsisting between Messrs. J. Littlehales and T. Clemmons, carrying on business as aluminium castings manufacturers at Lozells Road, Handsworth, Stafford, under the style of T. Clemmons & Company, has been dissolved.

THE partnership heretofore subsisting between Messrs. A. Marsden, H. D. Levick, and S. H. Jepps, carrying on business as iron founders, at Cargo Fleet Road, Middlesbrough, under the style of Mareden & Company, has been dissolved. Mr. A. Marsden will continue the business.

GIBB & HOGG, LIMITED, have practically closed their Victoria Engineering Works, Airdrie, with the advent of the Fair Holidays. The works have been in the market for some time, and rumours of the threatened stoppage have been in circulation for months. Nearly all the men were paid off on July 14th.

THE partnership existing between Messrs. J. Matthews and F. H. Smith, carrying on business as engineers and founders, at 91 and 93, Northumberland Street, Liverpool, under the style of Joseph Matthews & Company, has been dissolved. In future the business will be carried on by Mr. J. Matthews.

MESSRS. E. BIBB, G. E. BIBB AND W. A. BIBB, carrying on business as brassfounders, at Windmill Street, Horsefair, Birmingham, under the style of Edward Bibb & Sons, have dissolved partnership. Messrs. G. E. Bibb, W. A. Bibb and W. L. Bibb will henceforth carry on the business under the style of Edward Bibb & Sons.

GENT & COMPANY, LIMITED, have removed their London office from 3A, Upper Thames Street, E.C., to more commodious premises at 25, Victoria Street, S.W. This firm also, finding their office and stores in High Bridge, Newcastle-on-Tyne, too small for their business, have taken new premises at 52, Blackett Street, Newcastle-on-Tyne.

LEE HOWL & COMPANY, LIMITED, Tipton, Staffs., have recently completed an extension to the erecting shop at their Tipton Engineering Works. This extension, 80 ft. by 80 ft., is built on to the old erecting shop. There is a loading bay at one end, and the floor is served by a 10-ton Herbert Morris & Bastert crane.

EDGAR ALLEN & COMPANY, LIMITED, of Sheffield, have established an American branch at 71, Kilby Street, Boston, U.S.A. The concern has offices and warehouses, where stocks are carried, in Chicago, New York, Pittsburg, and Buffalo, and it is the intention to establish branches in other cities. The Boston branch will be under the management of Mr. H. B. Eaton.

ALL the castings for the Cunarder "Aquitania," now being built at Clydebank, with the exception of the stern frame and rudder, are to be made by Harland & Wolff, Limited, under a working agreement with John Brown & Company, Limited. These castings will be some of the largest ever made, the vessel being 5,000 tons larger than the "Olympic," and "Titanic."

ANOTHER large ingot has just been cast by Cammell, Laird & Company, Limited, at their Grimesthorpe Works, Sheffield. It weighed 130 tons, and was over 15 ft. long. At one end it was 9 ft. broad by 4 ft. 9 in. thick, and at the other 9 ft. 3 in. by 5 ft. Having been slabbed down to a thickness of about 3 ft. 6 in., and the scrap removed, reducing the weight to approximately 90 tons, a mild steel plate was rolled from it on July 4.

JNO. HY. ANDREW & COMPANY, LIMITED, of the Toledo Steel Works, Sheffield, have appointed Messrs. Bernard Holland & Company, of 17, Victoria Street, S.W., to act for them in future in London and district, so far as the British Government departments, railway companies, engineers, shipbuilders, contractors, etc., are concerned, the arrangement hitherto existing between Messrs. Campbell, Macmaster & Company, of 11 and 12, Clements Lane, E.C., and Messrs. Andrew having expired.

DER DEUTSCHE WELLMAN-SEAVER GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, the German branch of Wellman, Seaver & Head, Limited, have recently received an order in Germany for three 60-ton tilting furnaces of their latest design. These furnaces will be of the central rotating type, with all the various motions electrically driven, including the tilting of the furnace itself, also the door-lifting gear and port-moving gear. The furnaces will be built in Germany, but designed in London. It is satisfactory to note the success of the branch of a British firm in obtaining this important contract in the heart of Germany and in the face of keen German competition.

THE sixth congress of the International Association for Testing Materials will be held at New York and

(*Continued on page* 484.)

**T. E. MANSERGH.**

EVERY DESCRIPTION OF
**MOULDERS'**
PATENT WOOD, MINERAL and
**COAL DUST BLACKINGS**
MANUFACTURED.

**Wheathill Charcoal Works, SALFORD.**

**GANISTER, CUPOLA BLOCKS, FIRE BRICKS,**
**FIRE CLAY.**
***Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.***
**STEEL MOULDERS' COMPOSITION, SILICA CEMENT.**

**J. GRAYSON LOWOOD & Co., Ltd.,**
**DEEPCAR, nr. SHEFFIELD.**

**Telegrams: "LOWOOD, DEEPCAR."**

# SOUND

## STRONG, CLOSE-GRAINED

# CASTINGS

**Obtained by using**

# "TITANIUM THERMIT"

**TINS READY FOR USE.** **ALL SIZES from 2 cwt. to 20 tons.**

*Prices and Particulars from*

## THERMIT LIMITED,

**Telegrams: "FULMEN, LONDON."**
**Telephone: 3749 Central.**

27, Martins Lane,

*Works:* **210a, Bow Rd., E.** Cannon Street, E.C.

# ELDERS FOUNDRY COKE

**AS SUPPLIED TO THE**
**BRITISH**
**ADMIRALTY DOCKYARDS.**

**The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.**

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

## Elders Collieries, Ltd., Cardiff.

Washington in the beginning of September, 1912, under the auspices of the American Society for Testing Materials. Professor H. M. Howe, President of the Association, will act as President of the Congress, and Professor E. Marburg, of Philadelphia, as Secretary. The Congress will be divided into the Sections—A, metals; B, concrete, cement, stone; C, miscellaneous. Members desirous of taking part in the Congress are requested to notify their intention as soon as possible to the representative of the Association for Great Britain, Mr. G. C. Lloyd, Secretary of the Iron and Steel Institute, 28, Victoria Street, London, S.W.

THE CANADIAN P. J. MITCHELL COMPANY, LIMITED, which was recently registered with a capital of £21,000, divided into 20,000 6 per cent. £1 preference shares (cumulative and participating), and 20,000 1s. ordinary shares, has just made an issue of 20,000 preference shares at par. In addition to his business in Rateau patent exhaust steam plants, Mr. Mitchell has also secured sole agencies from the following firms for sale in the Dominion of their various manufactures, the benefit of which will be transferred to the company:—Greenwood & Batley, Leeds; Fullerton, Hodgart & Barclay, Limited, Paisley; Lassen & Hjort, London; Aster Engineering Company, Limited, Wembley, Middlesex; Higginbottom & Mannock, Limited, West Gorton, Manchester; Boulton & Paul, Limited, Norwich; Thomas C. Fawcett, Limited, Leeds; and L. Sterne & Company, Limited, Glasgow. The secretary of the company is Mr. J. F. Mitchell, and the offices are at Caxton House, Westminster, S.W. The managing director is Mr. P. J. Mitchell.

LAMBERT BROS. (WALSALL), LIMITED, have recently entered into occupation of their new works at Birchills, Walsall. For a considerable time the accommodation at Ablewell Street, where the company have been trading for rather more than 60 years, had been unequal to the demand made upon it. The management, therefore, decided to erect and equip entirely new works, to which end they purchased about 11 acres of land at Birchills, and erected works to meet their particular requirements, leaving ample room for future extensions. The works are bounded on the one side by the L. & N.W.R., and on the other by the canal, on which the company have a private basin. The offices front on to Green Lanes, from which also there is a gateway entrance to the works. These are divided up into three groups of buildings. On the one side is the smiths' and hammer shop, a lean-to building, 270 ft. by 20 ft. Blowers are driven by a horizontal steam engine, but as steam is raised solely by waste heat, a motor is installed as a standby to drive the blowers when the mill is not at work. The central position is taken up by a building 100 ft. long, covered by three bays, 25 ft., 50 ft., and 25 ft., and devoted respectively to the fitting stores, tube warehouse, and brass warehouse. Immediately at the rear of the warehouse is the machine shop, which is 100 ft. long, and covered by three bays, each 33 ft. wide, and devoted respectively to screwing fittings, tubes and general machine work and tool-making. The tube mill forms the rear of the centre block of buildings, and is covered by a corrugated iron roof, 100 ft. by 100 ft. The furnace, of the company's own design, is coal-fired, and the waste heat is used to raise steam under a Danks boiler, working at 80 lbs. In connection with the furnace is a Thompson steel stack, 110 ft. high. The mill is driven by a 60-h.p. horizontal engine by Midwinter, Birmingham. The mill, the machine shop, and the warehouse are connected up with lines of trolley track. The third group of buildings consists of the iron foundry, 100 ft. by 50 ft., the floor of which is served by a 3-ton manual crane, and general castings up to 20 cwts. are produced. The cupola, of a capacity of 2 tons per hour, and the blower were supplied by Alldays & Onions' Pneumatic Engineering Company, Birmingham. Pending the installation of a hoist, the cupola is being charged by hand. A separate line of buildings comprise the brass foundry, with core shop adjoining, rough brass stores, brass pattern shop, and the brass finishing shop, with testing shop at the end. Adjoining, and at the rear of these, is the general pattern shop and stores, a building 170 ft. by 25 ft.

## PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

| METALS. | End July, 1911. | End July, 1910. |
|---|---|---|
| Iron—Scotch pig warrants ton | *52/9 | *54/9 |
| —Middlesbro' warrants . ton | 46/11½ | 49/2½ |
| —W.C. M/nos Bessemer ... ton | 63 0 | 66 0 |
| —Stock, Scotch ... ...tons | 1,000 | 1,000 |
| Copper—Chili bars, GMB ton | £56 5 0 | £54 7 6 |
| —Stock, Europe and afloat tons | †70,172 | †103,957 |
| Tin—English ingots ... ton | £193 0,0 | £148 10 0 |
| —Straits ... ... ... ton | £190 0,0 | £149 2 6 |
| —Stock, London, Holland, U.S.A., and afloat ...tons | †17,121 | †16,452 |
| Lead—English pig ... ton | £14 3 9 | £13 0 0 |
| Spelter—Ord. Silesian ... ton | £25 1 3 | £22 7 6 |
| Quicksilver (75lb)... bottle | £9 0 0 | £8 12 6 |
| Antimony—Regulus .. ton | £28 10 0 | £29 10 0 £30 10 0 |

* Settlement price. † June 30.

### CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

| | £ s. d. | | £ s. d. |
|---|---|---|---|
| Columns (plain) ... ... ... ... | 6 10 0 | to | 6 15 0 |
| Pipes, 1½ to 2½ in. ... ... ... ... | 4 17 6 | to | 5 2 6 |
| ,, 3 to 4 in. ... ... ... ... | 4 10 0 | to | 5 0 0 |
| ,, 5 to 8 in. ... ... ... ... | 4 7 6 | to | 4 10 0 |
| ,, 10 to 16 in. ... ... ... ... | 4 7 6 | to | 4 10 0 |
| ,, 18 to 24 in. ... ... ... ... | 4 7 6 | to | 4 10 0 |
| Chairs ... ... ... ... ... ... | 3 12 6 | to | 3 15 0 |
| Floor plates (open sand) ... ... ... | 2 17 6 | to | 3 0 0 |

### SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 9s. 0d.; light wrought, £1 5s. 0d.; heavy cast, £2 6s. 0d.; all per ton, f.o.b., London. Copper (clean), £52 10s. 0d.; brass (clean), £39 0s. 0d.; lead (usual draft), £12 15s. 0d.; zinc, £20 0s. 0d.; all per ton delivered merchant's yard.

## New Companies.

ABBOTT'S EMERY MINES, LIMITED.—Capital £20,000 in £5 shares.

BALHAM WELDING SYNDICATE, LIMITED.—Capital £3,000 in £1 shares.

METAL DEPOSITING SYNDICATE, LIMITED.—Capital £1,500 in £1 shares.

AFRICAN STEEL SYNDICATE, LIMITED.—Capital £10,000 in £1 shares. Registered office: 34, Bishopsgate, E.C.

OXYGEN WELDING WORKS, LIMITED.—Capital £4,000 in £1 shares. Registered office: 74, Henrietta Street, Birmingham.

J. ROBERTS & COMPANY, LIMITED.—Capital £1,000 in £1 shares, to carry on the business of engineers' stores contractors, etc.

CRITALL CASTINGS COMPANY, LIMITED.—Capital £2,000 in £1 shares. Registered office: Upper Railway Street, Braintree, Essex.

DRYERS, LIMITED.—Capital £10,000 in £1 shares, to carry on the business of manufacturers and dealers in dryers, heaters, coolers, etc.

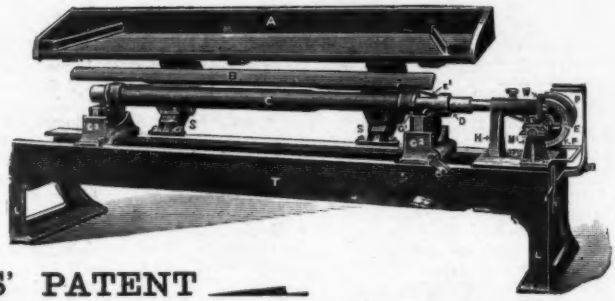
KIRKALDY & KEMP, LIMITED.—Capital £3,000 in £1 shares (1,000 6 per cent. cumulative preference), to carry on the business of engineers, etc.

DICKS, LIMITED.—Capital £5,000 in £1 shares (2,000 preference), to carry on the business of engineers, etc. Registered office: 149, High Street, Winchester.

LENNOX FOUNDRY COMPANY LIMITED.—Capital £25,000 in £1 shares (24,000 6 per cent. preferred

# THE UP-TO-DATE FOUNDRY

CONTAINS



W. JONES' PATENT

# GREEN SAND CORE MACHINES.

Many repeat orders received recently from users who have proved its economy.
It forms Cores in Green Sand from 2 ins. to 20 ins. diameter, any length.

**Machines in use in ENGLAND, GERMANY, SPAIN, SWEDEN, and INDIA.**

## JONES & ATTWOOD, STOURBRIDGE.

# A NEW STEEL BARROW

(PATENTED)

## "BRABY'S BALANCED BARROW."

The Handiest and Cheapest Barrow in the market. Specially designed for coal, dross, ashes, etc. Its capacity is **25 per cent. greater** than the ordinary style, yet it can be wheeled with **half the labour** and can be emptied **much more quickly**. It is a **perfectly balanced** barrow, and a full load can be **easily wheeled by a boy.**

**NOTE.—This Barrow can be taken right up to mouth of furnace and the ashes drawn into the barrow direct from the furnace.**

The "B.B.B."

**BRABY** for high grade **STEEL**
SHEETS & PLATES up to 15 FEET LONG.
RANGE of GAUGES 8 to 30 W.G.
RANGE of WIDTHS 12 to 60 in.

**BRABY** for improved wrought **STEEL**
BARROWS. BOGIES, TRUCKS.
GUTTERS. PIPES, &c.

**BRABY** for Iron and **STEEL**
ROOFS and BUILDINGS.

**BRABY** for unbreakable **STEEL**
SASHES, CASEMENTS, and
PUTTYLESS ROOFLIGHTS.

**BRABY** for galvanized corrugated **STEEL**
SHEETS: "EMPRESS" & "SUN" BRANDS

**FREDERICK BRABY & Co. Ltd.,** Eclipse Iron & Galvanising Works & Steel Sheet Rolling Mills, Petershill Road, GLASGOW.

Show Rooms and Aluminium Warehouse, 124, St. Vincent Street, Glasgow.
Rustless Iron, Galvanising and Copper Works, FALKIRK.

**Also at London, Deptford, Liverpool, Bristol, Belfast and Dublin. CONTRACTORS to BRITISH and FOREIGN GOVERNMENTS.** Teleg.—"Braby, Glasgow."

ordinary). Registered office: Crown Buildings, Crown Court, 62, Old Broad Street, E.C.

E. Parramore & Sons, Limited.—Capital £3,500 in £1 shares, to carry on the business of ironfounders, etc. Registered office: Caledonian Foundry, Smith Street, Chapeltown, Ecclesfield, Yorks.

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## Legal.

### Contract for Water Pipes.

The arbitration case at Lincoln Castle, before Mr. E. Pollock, Official Referee of the Supreme Court, in which the Staveley Coal and Iron Company, Limited, claimed from the Lincoln Corporation £15,778, under a contract totalling £28,406, to supply cast-iron pipes in connection with the new water undertaking, has been concluded. The Corporation made a counter-claim for a similar sum, and said the pipes were rejected at the Chestertfield works, and were re-numbered and sent back as passed pipes.

During the course of the evidence, Sir E. Carson said he wished to make a statement. Certain knowledge had come to hand which had satisfied Mr. Westlake, the managing director of the Staveley Company, that the company ought not to further contest the right of the defendants to have the contract terminated. The moment Mr. Westlake ascertained there were reasons to suppose that the pipes had been improperly dealt with, he did not hesitate for a moment to instruct him (Sir Edward) to that effect. So far as the company were aware, and having regard to the satisfactory way in which all other contracts were being carried on at the same time, it was thought impossible that this could have happened, but he (Mr. Westlake) was now satisfied that he was deceived, and that some persons, though it might be difficult to trace who they were, were tempted by reason of the unprecedented number of rejections in the Lincoln case being about 30 per cent., as compared with 2½ per cent. in the other contracts, to try and dispose of rejected pipes by tampering with them. The arrangements they had come to were these:—That plaintiffs were to take back, at their own expense, all pipes at present at the Corporation depots, or any pipes that had not been used; that the defendants should pay for all pipes they had actually used at the contract price; that the plaintiffs were to abandon any further claim under the contract; and that the defendants under the counter-claim should receive £3,000, and upon that the plaintiffs were to be relieved from any further liabilities under the contract. Of course, it followed that plaintiffs were to pay all the defendants' costs on the claim and counter-claim. The Referee would probably make an order that the sum of money paid into Court should be handed to the defendants.

The Referee also congratulated both parties and everybody concerned on the result. It was one which he thought was very satisfactory to everybody, because the case involved an enormous amount of expense. Unfortunately, somebody or some persons—for who, so far as he could see, the Staveley Company were in no way responsible morally, although they were legally, inasmuch as they were carrying out the contract—committed some gross fraud, which entitled the Lincoln Corporation to determine the contract. He could only say he thought Mr. Westlake had nothing whatever to do with the matter, and nobody, so far as he knew, connected with the Staveley Company, were aware of what was going on, until somewhere about March 21. He hoped there would be further investigation to arrive at the real facts, and said he supposed some order or judgment would be required.

Mr. Matthews suggested that the record be withdrawn upon these terms, with Judge's order, if necessary, and the Referee agreed.

## Parliamentary Notes

### Clay Cross Company's Contract.

Mr. William Thorne asked the Postmaster-General, in the Commons, on July 11, if he was aware that a labour dispute had taken place at the Clay Cross Works, Chesterfield, the company being contractors to the Post Office for the supply of telephone pipes, and that the company was not paying out the fair wages clause for Post Office contracts of March 10, 1909, and, if so, what action he proposed to take in the matter.

Captain Norton replied that no complaint had reached the Department of any failure on the part of the company to carry out the fair wages clause of its contracts. If the hon member would furnish him with particulars he would have an inquiry made.

### Dowlais Works Question.

Mr. Keir Hardie asked the Under-Secretary for India on July 11 whether he was aware that the standards and rolls for turning out rails for the India Office rails contract with Guest, Keen & Nettlefolds, Limited, at their Dowlais Works were made by moulders, and that without these the rails could not be made; and whether under these circumstances he would insist upon the firm complying with the provisions of the fair wages clause and pay their moulders 6s. per day, as was done by other works in the district for the same class of work; also, whether he was aware that the moulders now on strike at Dowlais, and who were employed at wages ranging from 2s. 11d. to 3s. 8d. per day, were performing work connected with the making of steel rails for the India Government, and whether he would inform the firm of Guest, Keen & Nettlefolds, that unless the terms of the fair wages clause in respect to wages and conditions of employment were complied with, he would have their name removed from the list of Government contractors.

Mr. Montagu: The fair wages resolution, as interpreted by the Government Departments concerned, does not extend to the manufacture of plant or tools used only partly in fulfilling Government contracts. If my hon. friend dissents from this interpretation, I will undertake to lay his contention before the Fair Wages Committee.

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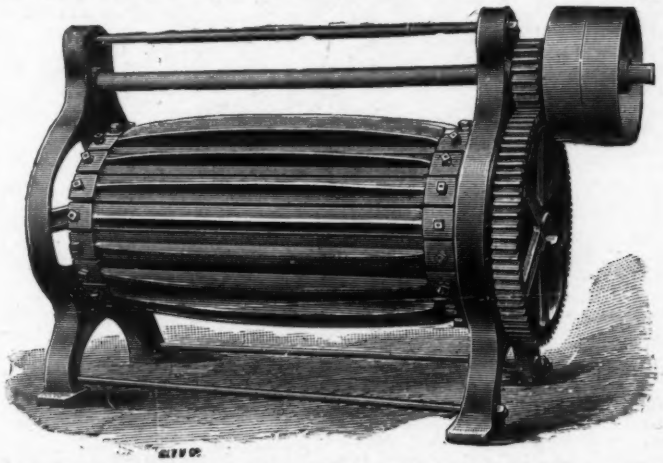

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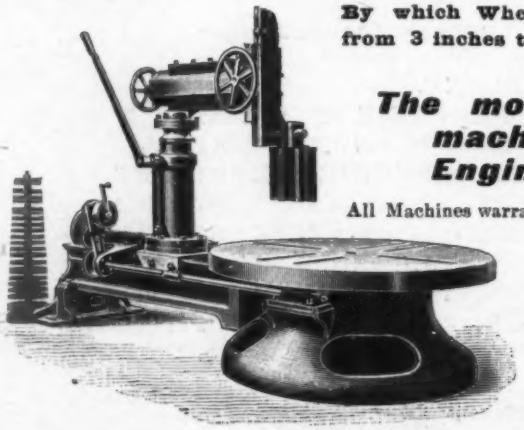

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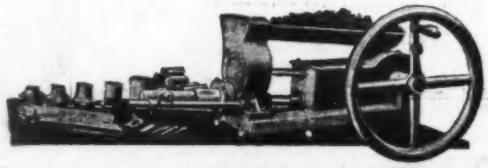

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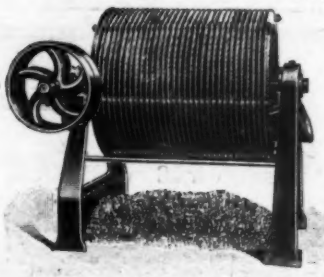

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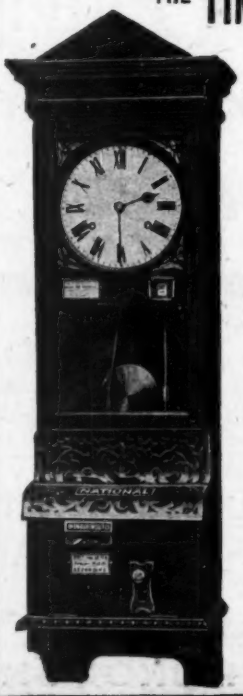


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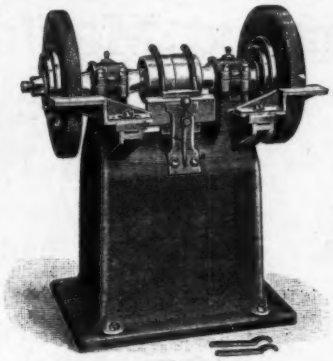

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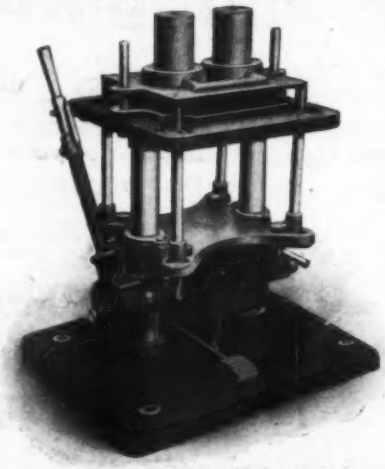

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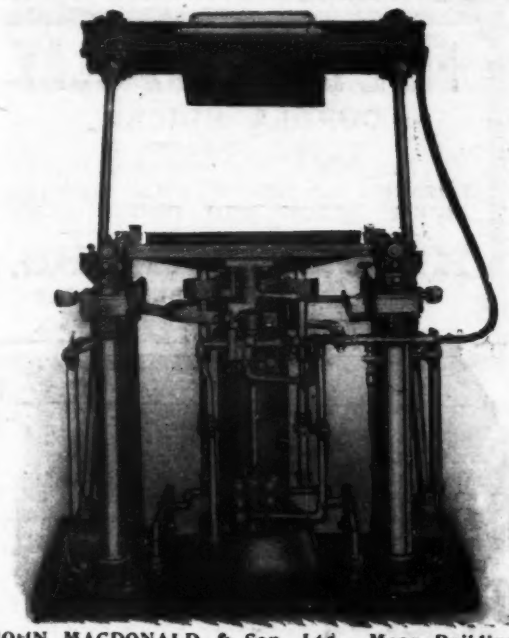

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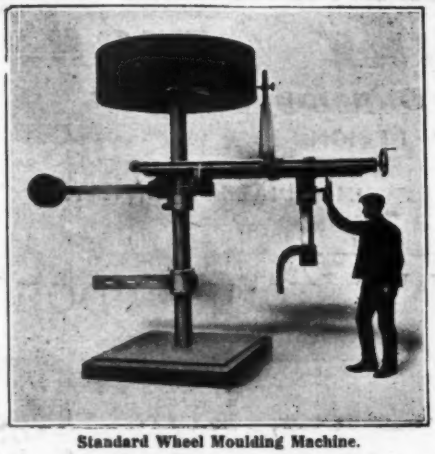

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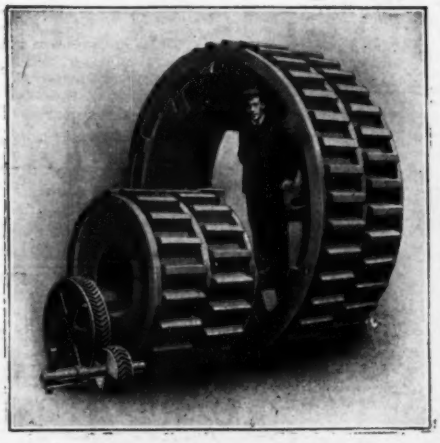

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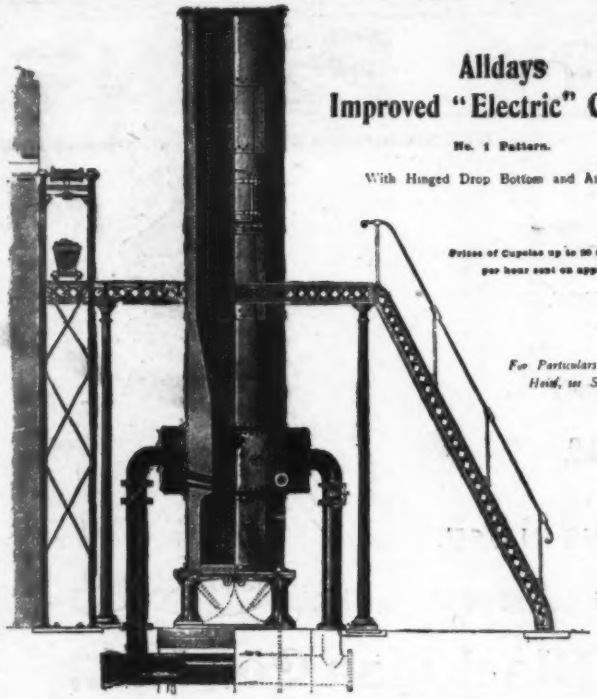

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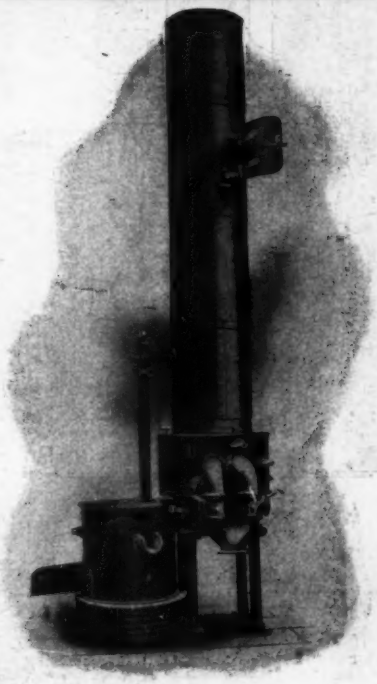

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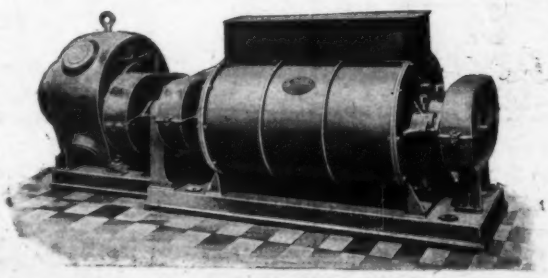

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